OIL POLLUTION OF BIRDS: AN ANNOTATED BIBLIOGRAPHY

Tracey D. Hooper
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ABSTRACT

The bibliography consists of 606 citations, most of which are annotated to provide a review of literature on the effects of oil pollution on birds. The literature cited covers the subject on a worldwide basis from 1922 to early 1986. This work includes and updates information cited in *Oil Pollution of Birds: An Abstracted Bibliography* by Vermeer and Vermeer (1974).

ABSTRAIT

La bibliographie consiste en 606 citations, la plupart est annotee pour fournir un rapport de la litterature sur les effets de la pollution petroliere sur les oiseaux. La litterature citee discute le sujet sur base mondiale de 1922 jusqu'au commencement de 1986. Ce travail comprend et rend plus recentes les informations citees dans *Oil Pollution of Birds: An Abstracted Bibliography* by Vermeer and Vermeer (1974).

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INTRODUCTION

This bibliography includes and updates the original work by Vermeer and Vermeer (1974), ***Oil Pollution of Birds: An Abstracted Bibliography***.

The authors have attempted to thoroughly cover, on a worldwide basis, the problem of oil pollution of birds; 606 works are cited dating from 1922 to early 1986. The original bibliography by Vermeer and Vermeer (1974) was arranged chronologically to show the evolution of the oil/bird problem. For ease of use, this bibliography is arranged alphabetically by senior author followed by junior author(s), if any. Works by the same author(s) are listed chronologically by date of publication.

To provide a review of the literature, abstracts accompany citations wherever possible. An asterisk (*) preceding a citation indicates the article was not available to the authors: hence, an abstract could not be provided. The notation at the end of an abstract denotes the source of the abstract.

aa - author's abstract
ac - author's conclusion
as - author's summary
ct - complete text
maa - modified author's abstract
mas - modified author's summary
st - summary of text

Abstracts without a notation were provided in Vermeer and Vermeer (1974).

Sources used in the literature search included reference lists of retrieved articles, as well as the following abstracting journals:

Biological Abstracts
Biological Abstracts/RRM
Bioresearch Index
Biosis Previews
Environmental Information Access
Oceanic Abstracts
Pollution Abstracts
United States Government Reports Announcements
United States Government Reports Index
Wildlife Review
Zoological Records

A literature search was made using Biosis Previews and Zoological Records databases in Dialog Information Services (Inc). Literature cited in ***A Classified Bibliography of Oil Pollution*** by A. Nelson-Smith (1968) and in the Santa Barbara Oil Spill Information Center, Index-Catalogue Volume III (1972), was incorporated into this bibliography.

Literature was retrieved from the following libraries, institutions, and organizations:

Academy of Natural Sciences - Philadelphia, PA
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Atmoshpheric Environmental Service - Downsview, Ont.
British Library - Boston Spa, Wetherby, West Yorkshire
Canada Institute for Scientific and Technical Information - Ottawa, Ont.
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National Museums of Canada - Ottawa, Ont.
Patuxent Wildlife Research Center - Laurel, MD
Simon Fraser University - Vancouver, B.C.
Technical University of Nova Scotia - Halifax, N.S.
United States Fish and Wildlife Service
United States National Agricultural Library - Beltsville, MD
University of Calgary - Calgary, Alta.
University of California - San Diego, CA
University of Guelph - Guelph, Ont.
University of Newcastle upon Tyne - Newcastle upon Tyne
University of Southern California - Los Angeles, CA
University of Western Ontario - London, Ont.
Wildfowl Trust - Slimbridge, Gloucester
Woodward Biomedical Library - University of British Columbia - Vancouver, B.C.
Zoology and Palaeontology Library - Royal Ontario Museum - Toronto, Ont.

Adams, N.K. 1936. The pollution of the sea and shore by oil. Report to Council of the Royal Society, London. 27 pp.

Advisory Committee on Oil Pollution of the Sea. Research Unit on the Rehabilitation of Oiled Seabirds. 1972a. Recommended treatment of oiled seabirds. Department of Zoology, University of Newcastle upon Tyne. 10 pp.

The Research Unit on Oiled Seabirds sets out recommendations designed for well equipped centers to treat oiled birds. The emphasis is on the quick return of natural water-repellency in birds by complete removal of any trace of oil, detergent, or fecal matter. Preliminary treatment before transporting birds to centers consists of keeping the birds warm in a dry cloth poncho and feeding them fish. Birds are packed loosely in ventilated cardboard boxes for transportation. Rehabilitation of the strongest birds has priority. When alert and able to stand, birds are washed in 1% solution of household detergent in hot water (40-45°C). Thorough washing and rinsing in hot water are essential as residual oil or detergent destroys water-repellency of feathers. Dried and kept warm, birds recover strength with a diet of fresh or frozen fish. Birds completely regain water-repellency if allowed to bathe and preen in an environment free of dirt and contamination. In 2-3 weeks, strong healthy birds may be released. Rehabilitated birds must be tagged before release to evaluate and further improve these procedures. (st)

Advisory Committee on Oil Pollution of the Sea. Research Unit on the Rehabilitation of Oiled Seabirds. 1972b. Second annual report, 1971. Department of Zoology, University of Newcastle upon Tyne. 32 pp.

The report reviews the activities of the Research Unit centered on the factors affecting water-repellency of feathers and the development of improved methods of cleaning oiled birds. Results of the investigations show the prime cause of loss of water-repellency is contamination of the feathers with traces of oil, cleaning agent, fecal or other matter. Of a wide range of cleaning agents tested, the domestic, water-soluble liquid detergents removed oil from feathers most effectively and required minimum rinsing while offering the advantage of availability, low cost and ease of handling. These were chosen over other detergents and detergent-based preparations such as Polycomplex A-11, Larodan 127, Panolec, Swarfega and Tremalon B.

Advisory Committee on Oil Pollution of the Sea. Research Unit on the Rehabilitation of Oiled Seabirds. 1973. Third annual report, 1972. Department of Zoology, University of Newcastle upon Tyne. 24 pp.

The first part of this report outlines the continuing work on cleaning and rehabilitating oiled seabirds, with details of oiling incidents in which the Unit's techniques were applied. The second part of the report assesses the patterns of behaviour seen in wild guillemots and the changes in these patterns shown by captive birds, so that optimal conditions for maintaining birds during rehabilitation and release can be determined. (st)

Advisory Committee on Oil Pollution of the Sea. Research Unit on the Rehabilitation of Oiled Seabirds. 1974. Fourth annual report, 1973. Department of Zoology, University of Newcastle upon Tyne. 27 pp.

The report presents further results of an investigation into the behaviour and related aspects of the biology of wild and captive auks. Also reported is some preliminary research into the food requirements of guillemots, and the involvement of the Unit in various oil pollution incidents. (st)

Advisory Committee on Oil Pollution of the Sea. Research Unit on the Rehabilitation of Oiled Seabirds. 1975. Fifth annual report, 1974. Department of Zoology, University of Newcastle upon Tyne. 28 pp.

Details are presented of the Unit's efforts to rehabilitate seabirds oiled in spills at Tyneside and in the Firth of Clyde. Important points of rehabilitation are discussed. Success rates of treating oiled birds are presented and analyzed. Further studies of guillemot behaviour deal with breeding success, rate of predation, and agonistic behaviour. (st)

Ainley, D., S. Morrell, J. Dobbs, C.R. Grau and T. Roudybush. 1978. Reproductive responses of Cassin's Auklets to orally administered Bunker C oil and eliminative responses in seabirds. Pacific Seabird Group Bulletin 5(1):48-49.

Female Cassin's Auklets (***Ptychoramphus aleuticus***) were force-fed gelatin capsules containing either 300 or 600 mg of Bunker C oil. These birds and a control group of females, along with their eggs and chicks, were observed throughout the breeding season. No significant differences in laying, hatching or fledging success were observed among the four groups. No significant differences were observed in yolk structure in eggs of either the oil-dosed or control birds. Oil may have passed too quickly through the auklets to affect their eggs. (st)

Ainley, D.G., C.R. Grau, S.H. Morrell, T.E. Roudybush, R.R. Le Valley and H.R. Huber. 1978. Influence of petroleum on egg formation and embryonic development in seabirds. ***in*** Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators. vol. 7. Boulder, Colorado. National Oceanic and Atmospheric Administration. 310-333.

The effects of brief exposure to an oil spill on the reproduction of Cassin's Auklets (***Ptychoramphus aleuticus***) and Western Gulls (***Larus occidentalis***) nesting on the Farallon Islands, California were appraised. Female auklets were given 0, 300, or 600 mg of Bunker C oil to study the effects of a single oral dose of oil on breeding pairs of auklets, and on egg production, hatching success, fledging success, egg yolk structure, and yolk composition. No significant differences in laying, hatching, or fledging success were observed among test groups. In a visual test, yolk structure and appearance were normal. Attempts were made to develop chemical methods for detecting pollution in eggs. Field observations on the effects of oil on gulls confirmed earlier results in which dosing was the principal problem. (st)

Ainley, D.G., C.R. Grau, T.E. Roudybush, S.H. Morrell and J.M. Utts. 1981. Petroleum ingestion reduces reproduction in Cassin's Auklets. Marine Pollution Bulletin 12(9):314-317.

Sublethal doses of petroleum reduced reproduction in a free-living seabird, Cassin's Auklet (***Ptychoramphus aleuticus***), nesting on Southeast Farallon Island, California. The proportion of birds laying eggs was reduced 9-13 days after ingestion by gelatin capsule of 300, 600 or 1000 mg Bunker C fuel oil, or 1000 mg Prudhoe Bay crude oil. In addition, among those auklets that eventually laid eggs, hatching was reduced by doses of 1000 mg of Bunker C but was unaffected by other treatments. Chick development after hatching was unaffected by any treatment. The total time of egg formation from onset of rapid yolk formation to laying was 13 days, and it is early in this period that auklets are vulnerable to petroleum. (as)

Albers, P.H. 1977. Effects of external applications of fuel oil on hatchability of Mallard eggs. *in* D.A. Wolfe (ed.). Fate and Effects of Petroleum Hydrocarbons in Marine Organisms and Ecosystems. Pergamon Press. New York. 158-163.

An experiment was performed to determine the toxicity of oil to incubating eggs. Number 2 fuel oil, a mixture of 9 paraffin compounds, and propylene glycol were applied to the surface of artificially incubated Mallard (***Anas platyrhynchos***) eggs. Seven groups of 50 eggs each were treated with 1, 5, 10, 20, and 50 µl of fuel oil, 50 µl of the paraffin mixture, and 50 µl of propylene glycol. Fifty untreated eggs served as a control. Microliter syringes were used to apply the liquid around the air cell end of the egg on the 8th day of incubation. Embryonic mortality was significantly greater ($P \leq 0.01$) in all oil treated groups and the paraffin mixture group than in the control group. Most of the embryonic mortality for the oiled eggs occurred within 72 hours of treatment. Hatching and post-hatching (4 weeks) weights of the ducklings in all treatment groups were not significantly different ($P \geq 0.01$) from the control. Thus, the transfer of even small quantities of oil to the egg surface is sufficient to reduce hatchability. (aa)

Albers, P.H. 1978. The effects of petroleum on different stages of incubation in bird eggs. Bulletin of Environmental Contamination and Toxicology 19:624-630.

Artificially incubated Mallard eggs were treated externally with 5 µl of No. 2 fuel oil or 5 µl of Southern Louisiana crude oil at various times during the incubation period. Embryos were most sensitive to petroleum during the first 10 days of incubation. Southern Louisiana crude oil was more toxic to Mallard embryos than No. 2 fuel oil. Hatching weights of ducklings from treated eggs were usually not different from hatching weights of control ducklings. Petroleum may cause bill abnormalities among embryos exposed to a lethal amount of oil early in incubation, but few external malformations of any kind were observed among survivors of the oil exposure. The breeding effort of colonial aquatic birds would be in the greatest danger from oil contamination when a large portion of the birds are in the early stages of incubation. (as)

Albers, P.H. 1979a. Effects of Corexit 9527 on the hatchability of Mallard eggs. Bulletin of Environmental Contamination and Toxicology 23:661-668.

After 6 days of incubation, Mallard (*Anas platyrhynchos*) eggs were treated with 1, 5, or 20 μl of crude oil, Corexit 9527, a 5:1 oil-Corexit mixture, or a 30:1 oil-Corexit mixture. Treatments were applied externally near the air cell. The developmental stage of dead embryos was noted. Ducklings were weighed and examined for gross malformations within 24 h of hatching. Eggs treated with 20 μl of crude oil, 5 and 20 μl Corexit 9527, and both oil-Corexit mixtures had significantly lower hatching success than the controls. Hatching weights were not significantly different between controls and treatment groups. (st)

Albers, P.H.** 1979b. Oil dispersants and wildlife. ***in C.H. Brown (ed.). Proceedings of the United States Fish and Wildlife Service Workshop. 67-72.

Albers, P.H. 1980. Transfer of crude oil from contaminated water to bird eggs. Environmental Research 22(2):307-314.

Pairs of breeding Mallard ducks were exposed to oiled water for 2 days during the first week of incubation. Hatching success of ducks exposed to 100 ml of Prudhoe Bay crude oil per square meter of water surface was significantly less than that of controls. Hatching success of ducks exposed to 5 ml of crude oil per square meter of water surface was less than that of controls but the difference was not significant. The presence of oil on the eggs of ducks exposed to oiled water was confirmed by chemical analysis. Thermocouple probes were used to monitor the egg and nest temperatures of some of the ducks in each of the three groups. Incubation temperatures of oiled females were not significantly different from those of the controls. The incubation behavior of females exposed to oiled water and the first-week survival of their ducklings was not affected by oil. (aa)

***Albers, P.H.** 1982. Effects of oil on avian reproduction: A review and discussion. Presented at The Effects of Oil on Birds. A Multidiscipline Symposium. 17-19 September 1982. The Wetlands Institute. Stone Harbor, New Jersey. 78-96.

Albers, P.H.** 1983. Effects of oil on avian reproduction: A review and discussion. ***in The Effects of Oil on Birds: Physiological Research, Clinical Applications, and Rehabilitation. A Multi-discipline Symposium. 1982. Proceedings. Tri-State Bird Rescue and Research, Inc. Wilmington, Delaware. 78-97.

Albers, P.H. and M.L. Gay. 1982. Effects of a chemical dispersant and crude oil on breeding ducks. Bulletin of Environmental Contamination and Toxicology 29:404-411.

The effects of Corexit 9527 oil dispersant, and crude oil sprayed with Corexit 9527 on breeding Mallards (*Anas platyrhynchos*) were evaluated. Water troughs in duck pens were either untreated or treated for 48 hrs with 100 ml of Prudhoe Bay crude oil (PBCO), 100 ml of PBCO followed by 10 ml of dispersant, or 10 ml of Corexit 9527 per m^2 of water surface. Following treatment, females completed incubation and remained with their ducklings for 1 week. Incubation temperatures, hatching success, egg loss, and duckling survival were recorded. The potential for crude oil sprayed with diluted Corexit 9527 to adhere to duck plumage was determined. Diluted Corexit 9527 failed to effectively disperse crude oil in the water troughs, hence only the effects of a mixture of oil and dispersant could be evaluated. The absence of differences among groups in general parental and incubation behavior, egg and nest temperatures, and duckling survival indicated that neither a light-tomoderate slick of undispersed oil or oil-Corexit 9527 mixture, nor Corexit 9527 at concentrations up to 53 ppm in water can be expected to reduce breeding success through behavioral changes. Since oil dispersion was poor, it could not be determined if chemically dispersed oil can adhere to bird feathers. (st)

Albers, P.H. and G.H. Heinz. 1983. FLIT-MLO and No. 2 fuel oil: Effects of aerosol applications to Mallard eggs on hatchability and behavior of ducklings. Environmental Research 30(2):381-388.

FLIT-MLO and No. 2 fuel oil are sprayed on wetlands for mosquito control during spring and summer. In one experiment to assess the effects of the spraying on birds, Mallard eggs were sprayed with amounts of No. 2 fuel oil equivalent to 2.34, 4.67 or 18.70 liters/ha, or FLIT-MLO equivalent to 9.35, 46.75, or 140.25 liters/ha, on Day 6 of incubation. In a second experiment, Mallard eggs were sprayed with 9.35, 46.75, or 140.25 liters/ha of FLIT-MLO on Days 3, 6, 12, or 18 of incubation. Hatchability of eggs sprayed with the highest treatment level of each substance was significantly lower than that of controls for the first experiment. Hatchability of eggs sprayed with FLIT-MLO in the second experiment was never significantly lower than that of controls. Ducklings from the first experiment, 36-48 hr old, were cold-stressed for 1 hr at 8°C and then immediately tested for their ability to respond to a fright stimulus. Ducklings from the group of eggs sprayed with 140.25 liters/ha of FLIT-MLO ran a significantly shorter distance from the fright stimulus than did controls. The effects of the heaviest exposure to FLIT-MLO (140.25 liters/ha) on egg hatchability and behavior of newly hatched young are uncertain because of the contradictory results for hatching success in the two experiments. However, normal applications of FLIT-MLO (9.35-46.75 liters/ha) or No. 2 fuel oil (2.34-4.67 liters/ha) do not appear to pose a threat to the embryos of breeding birds. (aa)

Albers, P.H. and R.C. Szaro. 1978. Effects of No. 2 fuel oil on Common Eider eggs. Marine Pollution Bulletin 9(5):138-139.

An oil spill near a breeding colony could result in the transfer of oil from the plumage and feet of incubating birds to their eggs. Microlitre amounts of No. 2 fuel oil were applied externally to Common Eider eggs in an island breeding colony in Maine. Clutches of eggs treated with 20 μl of fuel oil had significantly greater embryonic mortality than the control clutches when they were examined 7 days after treatment. The results are similar to those of an earlier study of artificially incubated Common Eider eggs and indicate that nest site conditions do not affect embryotoxicity of No. 2 fuel oil. (as)

Aldrich, E.C. 1938. A recent oil pollution and its effect on the water birds of San Francisco Bay area. Bird Lore 40(1):110-114.

A search of 6½ miles of beach polluted with oil from a leaking tanker yielded 264 dead birds. Mortality was highest for the California Murre (***Uria aalge***) followed by the Western Grebe (***Aechmophorus occidentalis***), White-winged Scoter (***Melanitta deglandi***), and Surf Scoter (***Melanitta perspicillata***). No dead Sanderlings (***Crocethia alba***) or Snowy Plovers (***Charadrius alexandrinus***) were found, though both species were observed to be stained with oil. The degree of oiling and the behaviour of various species of oiled birds are described. (aa)

Aldrich, J.W. 1970. Review of the problem of birds contaminated by oil and their rehabilitation. U.S. Bureau of Sports Fisheries and Wildlife, Resource Publication 87. 23 pp.

The methods that have been tried to date in cleaning oiled birds are reviewed. These include the preparations Larodan 127, Polycomplex A-11 and Tremalon B. No convincing evidence was found that the natural water-repellency can be restored to the cleaned feathers by any known method. Curing oiled birds of the toxic effects of ingested oil is basic to the success of any salvage effort and must be perfected for each species concerned. The problems involved in the care of cleaned oiled birds are largely avicultural. Difficulty depends on the reactions of different species of birds to captive conditions. Concerning these problems, aviculturists and zoo personnel have an expertise to be tapped. The only cases where birds cleaned of oil have apparently been successfully returned to the wild are those in which the birds had been held in captivity through the annual moult. It is believed that the inducement of a premature moult might be the most effective way of rehabilitating oiled birds.

Alexander, M.M. 1983. Oil, fish and wildlife, and wetlands (a review). Northeastern Environmental Science 2(1):13-24.

The impacts of some of the larger oil spills on fish and wildlife and the associated wetlands are reviewed. Whereas the initial impact might include extensive mortalities, the long-term effects are little understood at the present time.

Species that are active at the surface are most susceptible to immediate losses. Sublethal oiling tends to affect growth and survival of the young and reduce the reproductive performance of adults. Toxic components are absorbed through the skin or ingested while consuming food or cleaning their body covering.

The impact of oil on wetland vegetation varies with the type of oil, type of plants and the intensity of the spill. The cleanup process, used in removing oil from a wetland, can result in extensive damage to the biotic community. Care must be taken in determining the extent to which cleanup should be carried.

Fish and wildlife appear to have a remarkable ability to overcome adversities such as oil spills. (aa)

Alexandersen, K. and K. Lamberg. 1971. Oliedöden ved Samsö. (Oil spill at Samso). Feltornithologen 13:90-91. (in Danish)

Details of an oil spill at Samsö were assembled by Wildlife Biological Stations. Results are presented in tables showing the areas affected by the spill, the species of birds killed by oiling, and the locations in which dead birds were found. Many dead birds were hidden by seaweed, some were washed out to sea, and others were eaten by gulls or were dragged away by rats. Hunters were called in to destroy suffering birds.

Responsible authorities must be made aware of the importance of stopping all illegal dumping of oil at sea. Controls and fines must be enforced. Cooperation between authorities has to be assured. Contact between various institutions has not yet been made. (st)

***Allison, D.** 1981. Oil spill on the River Colne at Colchester. Bulletin of the Essex Nature Trust. Spring 1981:34.

***Amos, A.F.** 1980. Oiling of shorebirds in south Texas following the IXTOC 1 oil spill. Bulletin of the Wader Study Group. No. 30:36.

Ampleford, R. and P.E. Brown. 1959. Destruction of seabirds. Proceedings of the International Conference on Oil Pollution of the Sea. 3-4 July 1959. Copenhagen. 71-73.

The RSPCA's first winter survey of oiled birds around the British coasts was conducted from October to March, 1951-1952. The number of birds killed by oil, on and close to, British shores that winter was estimated at 50,000-250,000. Auks, scoters, divers and gulls were the principal species involved. The survey was repeated during the winter of 1952-1953, 1953-1954, and 1954-1955. The peak in number of birds killed occurred in January and February. The counts indicated some decline in total number of birds oiled from 1951-1954. In 1957, a survey was carried out through the whole year. The worst oiling occurred in January and February, while oiling during the summer months was comparatively light.

***Anker-Nilssen, T.** and O.W. Röstad. 1981. Undersökelser AV Oljeskadede Sjöfugler I Forbinelse Med Oljekatastrofen I Skagerrak Desember 1980/Januar 1981. (Investigations of damage by oil on seabirds in connection with the oil spill in Skagerrak, December 1980/January 1981.) Viltrapport No. 16:1-41.

Arnott, J. (ed.). 1981. A bad year for guillemots and Razorbills. Report of the Fair Isle Bird Observer 33:72-73.

Of 52 guillemots recovered away from Fair Isle in 1981, at least 46% were oiled. Nearly half the oiled guillemots were from the Skagerrak disaster. Mortality was largely confined to birds in the first two years of life. Oiled Fair Isle Razorbills were found on the coasts of Northumberland and northern France; none were reported from the Skagerrak. (st)

Austin-Smith, P.J. 1968. Late winter oil pollution in the Bay of Fundy, Nova Scotia. Canadian Field Naturalist 82(2):145-146.

Of the dead oiled birds found, White-winged Scoters (***Melanitta deglandi***) were the most numerous. Laboratory examination of 7 dead, oiled birds showed these to have suffered from starvation and the toxic effects of ingested oil. (maa)

***Azzolini, A.** 1978. Bretagna anno zero. Pro Avibus 13(1-2):4-5.

Baillie, S.R. and C.J. Mead. 1982. The effect of severe oil pollution during the winter of 1980-1981 on British and Irish auks. Ringing and Migration 4(1):33-44.

Recoveries of ringed guillemots and Razorbills were used to investigate the effects of the severe oil pollution over much of north-west Europe in winter 1980-81 on British and Irish auk populations. Except for the Skagerrak incident, the majority of deaths were caused by chronic pollution from unidentified sources. Comparison with the ringing results from the 12 winters 1967-68 to 1978-79 showed a significantly higher percentage of recoveries reported as oiled for first year guillemots and adult Razorbills. Overall recovery rates indicate that first year guillemots, immature guillemots and adult Razorbills experienced increased mortality in the winter of 1980-81. Regional differences in recovery rates of first year and immature guillemots showed that Orkney, Shetland and East Coast populations were most severely affected. We speculate on the likely changes in breeding populations if the increased mortality acts in a density-independent manner. Guillemot breeding populations may decline on average by 6% to 9% over a five year period, mostly in 1985 when the majority of the 1980 cohort would normally be recruited to the population. Razorbills may experience an immediate decline of 3% to 6%. Other, unidentified, European breeding populations of auks must also have suffered increased mortality during the winter of 1980-81, as recoveries indicate that birds of British origin were insufficient to account for the numbers found dead on European beaches. (as)

Ballot, J.-N. 1979. Effets de la marée noire du Böhlen sur les oiseaux marins. Penn ar Bed. No. 97:73-76.

Crude oil spilt from the tanker ***Böhlen*** affected the Brittany coast, including the coast near Lilia-Plouguerneau and Blancs-Sablans. Although 268 oiled birds were recovered, some of these may have been victims of illegal oil dumping. The birds most affected were guillemots, auks, gannets, and puffins. An overview is given of attempts to clean the birds. Only 12 gannets (***Sula bassana***) were released in good condition. (st)

Barclay-Smith, P. 1930. Progress made in combatting oil discharges at sea. Bird Lore 32(3):397-400.

Observations around the British, German, Dutch, and Belgian coasts show that diving birds, particularly the guillemot (***Uria aalge***), Razorbill (***Alca torda***), Black Scoter (***Melanitta nigra***) and puffin (***Fratercula arctica***), suffer the greatest from oil pollution. The main sources of oil pollution are leakages and ballast waters from oil-driven and oil-carrying vessels. Installation of separators in ships was deemed necessary to prevent oil pollution.

*__Barclay-Smith, P.__ 1931. The destruction of birds by oil pollution at sea and the progress made since 1925 in combatting this. Proceedings of the International Ornithological Congress. 1930. Amsterdam. 7:503-508.

Barclay-Smith, P. 1956. Oil pollution. Bird Notes 27:81-83. The article reviews the progress in intergovernmental cooperation to combat oil pollution.

Barclay-Smith, P. 1967. Oil pollution - an historical survey. Journal Devon Trust for Nature Conservation, July Supplement, 'Conservation and the ***Torrey Canyon***'. 3-7.

A review is given of the progress in international agreements achieved by various organizations and governments since the 1920's towards combatting oil pollution of the sea. The latest effort to date is to establish an international fund and agreement to provide means of dealing with oil disasters caused by accidents such as the ***Torrey Canyon***.

*__Barnes, S.H.__ and D.G. Rosie (eds.). 1983. The Effects of Oil on Birds: Physiological Research, Clinical Applications, and Rehabilitation. Wilmington, Delaware. Tri-State Bird Rescue and Research.

Barrett, R. 1982a. Olje og sjöfugl - truer oljevirksomheten nord for 62° N sjöfuglene? (Oil and seabirds - does the oil activity north of 62° N threaten Norway's seabirds?). Var Fuglefauna 5(2):78-81. (in Norwegian with English summary)

The Norwegian coast is internationally important as a breeding area for seabirds. Over 80% of the 1-2 million pairs of auks and kittiwakes breed north of the Arctic Circle. Many thousands of seabirds and sea ducks also spend the winter in the ice-free fjords along the coast, while some fjords are important moulting grounds for ducks during the late summer and autumn. Other fjords are also important feeding areas during migration.

As yet oil activity north of 62° N is restricted to the summer months and thus "only" threatens the breeding populations, but there are signs that this activity will be extended into the autumn and even throughout the year. The main sea currents off the coast of Norway flow northwards. Thus any oil spill on any of the oil fields will be a potential threat to the vast numbers of birds found in north Norway at any one time. (as)

Barrett, R. 1982b. Sjöfuglkatastrofen i Varanger-fjorden-en farklaring og vurdering. (Seabird kill in Varangerfjord 1979). Var Fuglefauna 5(2):100-102. (in Norwegian with English summary)

In March 1979 an estimated 10-20,000 seabirds were killed by a small oil spill in Varangerfjord in East Finnmark. Over 90% of the casualties were Brunnich's Guillemots. Huge numbers of this species were concentrated in the area to feed on the capelin which annually spawn off the coast of Finnmark at that time of year. It is assumed that the Brunnich's Guillemots originated from vast colonies in the Barents Sea, eg. Novaya Zemlya, and that little damage was done to the overall breeding population of the species. (as)

Barrett, R.T. 1979. Small oil spill kills 10-20,000 seabirds in north Norway. Marine Pollution Bulletin 10(9):253-255.

An estimated 10-20,000 seabirds were killed by a very small oil spill off the coast of north Norway in March 1979. Despite the fact that over 90% of these were Brunnich's Guillemots (***Uria lomvia***), the breeding population of this species was not considered to have been seriously threatened by this spill. On the other hand, this episode did illustrate how extremely vulnerable certain seabird species are to oil. (as)

***Battelle - Northwest**. 1967. Oil spillage study, literature search, and critical evaluation for selection of promising techniques to control and prevent damage. Report to Department of Transportation, U.S. Coastguard. by Pacific Northwest Laboratories, Battelle Memorial Institution. Richland, Washington, U.S.A.. 281 pp.

***Becker, P.H.** and A. Schuster. 1981. Vergleich der Verölung von Vögeln nach Arten, Jahren und raumlicher verteilung aus der deutschen Nordseekuste in den Jahren 1972 und 1974-1980. Bericht int. Rat Vogelschutz dt. Sekt 20(1980):55-61. (in German)

Beer, J.V. 1968a. Post-mortem findings in oiled auks dying during attempted rehabilitation. Symposium on the Biological Effects of Oil Pollution on Littoral Communities. 17-19 February 1968. Pembroke, Wales. 123-129.

The period of rehabilitation of oiled auks was divided into four phases - from the time the birds were shipped from Cornwall, England, where they had been picked up, to the time of release of surviving birds.

Phase 1: lasted 3/4 day. Very heavy mortality. High death rate attributed to additional stress of a long journey, handling and settling of birds sick from enteric and pulmonary conditions.

Phase 2: 3/4 day - 4 days long. Heavy mortality. Characterized by an increase in renal changes and a high incidence of acute enteric and pulmonary diseases.

Phase 3: 4 days - 3 weeks. Low mortality. Change over from acute conditions of phases one and two to more chronic conditions of phase four.

Phase 4: 3 weeks - 28 weeks. Low mortality. Characterized by deaths from chronic pulmonary conditions, arthritis and renal failure.

Beer, J.V. 1968b. The attempted rehabilitation of oiled seabirds. Wildfowl 19:120-124.

The methods used for managing, cleaning, and feeding seabirds oiled in the ***Torrey Canyon*** disaster are described. The acute and chronic diseases developing in captivity are investigated, as are methods of treatment. The rapid restoration of waterproofing is considered the crux of the problem. Despite much effort, few birds could be returned to the sea and their long-term survival is in doubt. More research is needed before attempted rehabilitation can be considered a satisfactory alternative to humane destruction.

Beer, J.V. 1970. Treating oiled birds. Marine Pollution Bulletin 1(6):84 85.

The problems of coping with a large number of oiled birds are exemplified in the experience of the RSPCA Wild Bird Hospital at Mousehole, Cornwall. The sudden arrival of a large number of birds placed a severe strain on local resources. Birds needed individual attention for much of the time, thereby limiting the number handled to about 20 birds per person. Emaciation and arthritis were prevalent. The long time required to regain water-repellent plumage remained the greatest problem.

Belterman, T. and R. de Vries. 1972. Aftermath of an oil spill in the Amer River, Holland. Biological Conservation 4(2):146-148.

On 27 December 1970, a supply-tank containing 16,000 tons of crude oil nr. 3500 burst open. The tank, owned by the Provincial Electricity Plant, was located on the south bank of the Amer River, near Geertruidenberg, a short distance upstream of the 'Brabantse Biesbosch', an inland delta area of 120 km² lying between the southern tributaries of the Rhine and Meuse Rivers. Of this isolated region, 845 ha are protected as a state nature reserve. Many kilometres of river-bank were seriously contaminated and at least 5000 birds were killed. The most seriously affected species were Mallards, Whitefronted Geese, Bean Geese, Greylag Geese, Pochards, Tufted Ducks, Bewick's Swans, coots, moorhens, and gulls. (st)

Berding, H.H. 1968. Über das Auftreten von Salmonellen nach der Ölpest in England. (Occurrence of ***Salmonella*** after an instance of oil pollution in England). Gesundheitswesen und Desinfektion 60(3):43-44. (English translation available as Canadian Wildlife Service TR-GER-83)

The conditions in holding stations for birds oiled during the ***Torrey Canyon*** disaster were found favourable for the spread of ***Salmonella***. All birds exhibited fecal contamination as a result of crowding about 200 birds in an area of 20-32 m², cleaned only once a day. Tests for the presence of ***Salmonella*** on 18 specimens gave 2 positive results. ***S. enteritidis*** was found in the drinking water of one station and ***S. give*** in the feces of one guillemot. Although the percentage of contamination was low, it was sufficient under the given conditions to cause a general infection of the station. Over 70% of the deaths of rescued birds during the first week were due to diarrhea. This provides further evidence for the presence of enteritis-causing bacteria.

***Berglund, B.** 1976. (Our brutal age). Sveriges Natur 67(7):292-295. (in Swedish)

Bergman, G. 1961. Allin ja mustalinnun muuttokannat Keväällä 1960. (The migrating populations of the Long-tailed Duck and the Black Scoter in the spring, 1960). Suomen Riista 14:69-74. (English translation available as Canadian Wildlife Service TR-FIN-9).

As a consequence of the recurring heavy mortality by oil pollution, the numbers of Long-tailed Ducks (***Clangula hyemalis***) migrating through Finland by 1960 had been reduced to 1/10 the number recorded in the late 1930's. The number of Black Scoters (***Melanitta nigra***) was about the same as earlier. The total number of Black Scoters migrating in the spring of 1960 was estimated roughly up to 2,000,000 while that of the Long-tailed Duck did not seem to exceed 350,000.

Berkner, A.B., D.C. Smith and A.S. Williams. 1977. Cleaning agents for oiled wildlife. American Petroleum Institute Publication 4284:411415.

The advantages and disadvantages of different cleaning agents were assessed according to the species of wildlife oiled, the kind of oil involved, and the equipment and facilities available. Twenty-two commercial detergents were tested - seven were ranked by their ability to remove eight specific types of oil. Optimal concentrations and toxicity data were presented. Solvents that have proven effective and others that could potentially be effective in cleaning oiled animals were listed. (st)

Bibby, C. and W.R.P. Bourne. 1972. Trouble on oiled waters. Birds 4:160 162.

Results of the beached bird survey around the British coast on the last weekends of September, November, January, February, and March 1971-1972, confirmed that these months cover the period of greatest oil pollution and seabird mortality. The number of dead birds was highest in February while that of dead oiled birds reached a maximum in the early months of the year. Of a total of 7,610 km covered, 3,663 corpses were found 39% of which were oiled. An international beached bird survey on February 26-27, 1972, in England, Scotland, Ireland, Germany, and France showed that the British Isles collect most of the dead auks and other true seabirds such as fulmars and gannets. The incidence of dead divers, grebes, eiders, and scoters was greater in continental waters.

Bibby, C. and W.R.P. Bourne. 1974. Pollution still kills. Birds, Royal Society for the Protection of Birds Magazine 5(1):30-31.

Results from the beached bird survey in winter 1972-73 indicated a low level of oil pollution on British shores for the second consecutive winter. Auks, especially guillemots, were most seriously affected by oiling except in two separate incidents where Great Crested Grebes, scoters, and divers headed the casualty lists. In an experiment to determine the total number of birds killed based on results of the beached bird survey, 400 gull corpses were ringed and dropped at sea. Nearly 60% of the corpses washed ashore. The international beached bird survey showed a pattern of serious oil pollution stretching from the channel coasts of France through Belgium, the Netherlands, and Germany to Denmark. (st)

Biderman, J.O. and W.H. Drury. 1980. The effects of low levels of oil on aquatic birds. United States Fish and Wildlife Service, Biological Services Program. FWS/OBS-80/16. 5 pp.

The reproductive period, including the time of growth and development of the young, is a highly sensitive time for any animal when physiological systems are acting at critical rates. Any slight interference, such as the addition of a stressful or toxic agent is likely to be disastrous. It has been demonstrated that exposure of adult waterbirds or their developing young to slight amounts of petroleum can seriously interfere with the reproductive process. Effects can range from interference with the physiology of reproduction to killing of embryos, production of developmental defects, stunting of growth and impairment of survival ability when birds are stressed. Oil can be taken up by adults in their food or picked up on their feathers, and from them can be transferred to eggs or nestlings.

Managers should be conscious of these effects, which though less apparent in nature, may in fact be more serious than the infrequent kill-offs occurring after catastrophic spills. For it may well turn out that a chronic reduction in reproductive success may be the most significant effect of oil pollution on populations of aquatic birds. (as)

Bird Lore 34(1):109. 1932. Oil in the coastal water kills waterfowl.

This is a brief report of ducks and geese killed by oil which had been pumped overboard from a grounded tanker at Pamlico Sound, North Carolina, U.S.A..

Birds, Royal Society for the Protection of Birds Magazine 5(8):11. 1975a. Cape colony hit by pollution.

At Bird Island, Lambert Bay, 150 miles north of Cape Town, South Africa, an estimated 5000 Cape Cormorants, 700 gannets, and more than 100 Jackass Penguins were found dead or dying. The birds had been oiled with fish oil discharged from a fish factory. As far as was known, this was the first time fish oil had caused bird deaths in South Africa. (st)

Birds, Royal Society for the Protection of Birds Magazine 5(7):14. 1975b. Turning the tide against pollution.

Percentages of oiled bird corpses found in the 1972-73 and 1973-74 priority and international beached bird surveys are given. Thirteen oiling incidents involving the deaths of 60 or more birds were reported in a 12 month period. The worst incident was on the Firth of Clyde - at least 820 birds died. Three oil spills occurred on the Cromarty Firth. The first two spills affected 140 swans, 21 of which were Whooper Swans. Forty swans died despite the efforts of the Scottish Society for the Prevention of Cruelty to Animals. (st)

Birds, Royal Society for the Protection of Birds Magazine Jan/Feb:33-34. 1976a. Bird kill.

A total of 8450 birds was found in bird-kill incidents in Britain and Ireland. Thirty-one per cent of all corpses were oiled. Damages to birds following four different tanker spills are mentioned. An international survey revealed heavy mortality and oiling on the Dutch and German coasts due partly to oil spillage which killed at least 1290 sea ducks. Before the survey, another 1128 oiled corpses, mostly scoters, were found on the Dutch coast following a tanker spill. (st)

Birds, Royal Society for the Protection of Birds Magazine Winter:57. 1976b. Pollution - cause for concern.

The international beached bird survey for February - March 1976 indicated that pollution may be on the increase again around British and European shores. Oiled birds accounted for 34% of 513 dead birds recovered in north and east Scotland, 5% of 292 birds found in northwest England, 47% of 259 birds from north-east England, and 62% of 154 recovered from south-east England. The importance of monitoring the effect of the North Sea oil industry on seabirds is emphasized. (st)

Blokpoel, H., R.D. Morris and G.D. Tessier. 1984. Field investigations of the biology of Common Terns (***Sterna hirundo***) wintering in Trinidad. Journal of Field Ornithology 55(4):424-434.

Surveys made between January 19 and February 2, 1982 on the south-west coast of Trinidad revealed several instances of oil leaking from offshore oil facilities. Several oiled Common Terns (***Sterna hirundo***) were found in the study area at Icacos Beach. Two terns were severely oiled and probably would not have survived. In April or May 1982, bands from five oiled terns were collected. The birds had been banded as chicks in coastal colonies in New York, Maryland, Connecticut, or Rhode Island during 1981. (st)

Boenigk, G. and G. Pucka. 1980. Basstölpel (***Sula bassana***) im Landkreis, Hannover. Vogelkundliche Ber. Niedersachs. 12(3):80. (in German)

An oiled, dead gannet was found inland in Hannover, April 1980. (st)

Boersma, P.D. 1986. Ingestion of petroleum by seabirds can serve as a monitor of water quality. Science 231 (4736):373-376.

The ingestion by seabirds of fossil fuel hydrocarbons and other pollutants has been of great interest. This paper reports that storm-petrels ingest petroleum at sea and that residues can be detected in their stomach oil. The incidence of gut samples containing fossil fuel hydrocarbons (dirty samples) increased significantly after oil spills, and significantly more birds regurgitated dirty samples after large nearby spills than small distant ones. This appears to be one of the first reported instances where individuals of a natural population of marine birds have been shown to ingest sublethal doses of oil from sources of low-level, long-term pollution or from oil spills. Because of certain natural traits, Procellariiformes could serve as monitors of pollutants in the marine environment. (aa)

***Booy, J.C.** 1972. Fuel oil victim count. Maandblad de Pieper 11(3):21. (in Dutch)

Bourne, W.R.P. 1965. The weather, oil, and seabirds cast ashore. Seabird Bulletin 1:42-43.

Beached bird surveys provide evidence for incidence of oil pollution and a source of general ornithological information. Around the British coasts, surveys have been organized by the Royal Society for the Protection of Birds and the British Branch of the International Committee for Bird Preservation.

Bourne, W.R.P. 1967. The ***Torrey Canyon*** disaster. Seabird Bulletin 3:4-11.

Observations along the southern coast of Cornwall following the ***Torrey Canyon*** disaster indicated that the majority of birds were unaffected. Cormorants and Shags were present in nearly full force at their colonies. Flocks of turnstones (***Arenaria interpres***) and Purple Sandpipers (***Erolia maritima***) were present all along the cliffs. Gulls and fulmars were observed on the 'gull rocks'. But most auk sites were empty and only a few auks were seen. On the sea, only two divers were seen during the day's trip. The damage to birds is estimated to have been 30,000-100,000. The species most affected were guillemots (***Uria aalge***) and Razorbills (***Alca torda***).

Bourne, W.R.P. 1968a. Observations of an encounter between birds and floating oil. Nature 291:632.

Observations of guillemots (***Uria aalge***), Herring Gulls (***Larus argentatus***) and kittiwakes (***Rissa tridactyla***) seem to indicate that these birds take little notice of oil on water unless it is thick and they come into direct contact with it. A gull reacted to large patches of oil by flying while the guillemot dived and surfaced at random. These reactions help explain why guillemots suffered heavy casualty while the more numerous gulls escaped almost unharmed in the ***Torrey Canyon*** disaster.

Bourne, W.R.P. 1968b. Oil pollution and bird populations. Symposium on the Biological Effects of Oil Pollution on Littoral Communities. 17-19 February 1968. Pembroke, Wales. 99-121.

A historical survey of oil pollution of birds (mostly in Europe and North America) is presented. Elsewhere there is less information. Future research and the activities of the British Seabird Group are discussed. The effects of oil contamination on individual species are assessed.

Bourne, W.R.P. 1969. Chronological list of ornithological oil pollution incidents. Seabird Bulletin 7:3-8.

The article gives a list of oil pollution incidents from 1754, when ships were first noted polluting, to 1968.

Bourne, W.R.P. 1970a. Oil pollution and bird conservation. Biological Conservation 2(4):300-302.

It is argued that control of oil pollution and conservation of breeding stock are more effective in combatting the reduction in numbers of a species severely damaged by oil pollution than is rehabilitation of oiled birds. It is suggested that if birds are rehabilitated (for humanitarian reasons), it is unsatisfactory to release them immediately to their natural environment. A breeding population of semi-captive rehabilitated birds should be established in protected areas.

Bourne, W.R.P. 1970b. Special review — After the ***Torrey Canyon*** disaster. Ibis 112 (1):120-125.

Literature on oil pollution following the ***Torrey Canyon*** disaster is reviewed and the various studies and conclusions are discussed.

Bourne, W.R.P. 1971. The threat of oil pollution to northern Scotland seabird colonies. Marine Pollution Bulletin 2(8):117-119

A report of the recent oil pollution incident in northern Scotland in which 1,200 dead birds, mainly guillemots, were found and up to 10,000 may have died. It emphasizes that, with the increasing likelihood of oil pollution in this area, the seabird communities will need to be watched and protected not only during the breeding season but all the year round. (as)

Bourne, W.R.P. 1972. Ducks die in the Forth. Marine Pollution Bulletin 3(4):53.

Up to 30,000 wintering scaup and numerous other sea ducks in a dense mass feed on the untreated sewage at the Firth of Forth at Seafield, Scotland. A very small oil slick caused some hundreds of oiled birds, mostly scaup, to come ashore. The casualty in this incident is relatively small but it serves to demonstrate the extreme vulnerability of concentrated bird populations to oil pollution.

Bourne, W.R.P. 1975. Scotched birds. Marine Pollution Bulletin 5(4):52.

In early February, 1972 (Mar. Poll. Bull. 3(5):66-67, 1972) an unknown quantity of fuel oil was discharged via an outlet pipe from Dalmore distillery into the Cromarty Firth, Easter Ross, north-east Scotland; and on 9 February, a further 300 gallons were similarly lost from the Invergordon distillery nearby, when an oil tank was over-filled.

The material discharged from these pipes attracts large numbers of wintering wildfowl and 200 out of some 278 Mute Swans among them became oiled. Other species include Whooper Swans (***Cygnus cygnus***), goldeneye (***Bucephala clangula***), Tufted Duck (***Aythya fuligula***), and scaup (***Aythya marila***). This is now the thirteenth oil pollution incident in recent years in this increasingly industrialized area also noted for its wildlife, and already the site of the Dewdale oil spill (event 21-72). (ct)

Bourne, W.R.P. 1976. Seabirds and pollution. ***in*** R. Johnston (ed.). Marine Pollution. Academic Press. London. 403-502.

Among the topics discussed is the effect of oil pollution on seabirds. Oil spills around Great Britain, Italy, and eastern North America, and in the Baltic, southern North Sea and North Pacific are mentioned. Seabird breeding and moulting characteristics, and roosting and feeding habitats are outlined. (st)

Bourne, W.R.P. 1981. Winter colony attendance by auks and the danger of oil pollution. Scottish Birds 11(8):254-257.

Surveys of auk colonies in the Hebrides from 1970-1975 clarified patterns of seasonal attendance and emphasized the risk of oil pollution during seasons when the birds were not thought to be in attendance. (st)

Bourne, W.R.P. 1982. Concentrations of Scottish seabirds vulnerable to oil pollution. Marine Pollution Bulletin 13(8):270-273.

The diving birds most vulnerable to oil pollution normally appear to concentrate in areas of tidal mixing indicated by the development of cooler surface water temperatures offshore. This is not always a reliable guide to their location because they move about with the weather, however, and a survey needs to be made at the time of each incident. The most hazardous situation occurs when sustained onshore winds drift first the birds and then the oil against the coast. (as)

Bourne, W.R.P. and C.J. Bibby. 1975. Temperature and the seasonal and geographical occurrence of oiled birds on west European beaches. Marine Pollution Bulletin 6(5):77-80.

Oiled birds appear to be a more common aspect of oil pollution in cold water than in warm water. At higher temperatures, liquid oil is reduced to inert solid residues (tar balls) more rapidly than at cold temperatures and thus, is comparatively harmless to birds. (mas)

Bourne, W.R.P. and T.R.E. Devlin. 1969. Birds and oil. Birds 2(7):176-178.

Sample counts of the RSPB 1966-67 Beach Survey of Oiled Birds, dead or alive, around the British coast revealed that guillemots (***Uria aalge***) and Razorbills (***Alca torda***) were most affected, followed by gulls and terns combined, and wildfowl, of which the most important was the Black Scoter (***Melanitta nigra***). Over half of the diving species were dead by the time they were found, whereas half the waders and two thirds of the gulls were still alive.

Bourne, W.R.P., J.D. Parrack and G.R. Potts. 1967. Birds killed in the ***Torrey Canyon*** disaster. Nature 215:1123-1125.

An estimated 30,000 seabirds perished in the ***Torrey Canyon*** disaster. In a sample of 1233 dead birds of 8 different species, 97% were guillemots (***Uria aalge***) and Razorbills (***Alca torda***). A high proportion of the birds killed were immature, especially among the more northern populations involved.

Bowman, R.S. 1978. Dounreay oil spill: Major implications of a minor incident. Marine Pollution Bulletin 9(10):269-273.

Over the weekend of 12-13 February 1977, approximately 1700 gallons of 900 second Medium Furnace Fuel Oil leaked onto the shore via an outfall at Dounreay, Caithness. The first obvious effect of the spill was on seabirds. The Royal Society for the Protection of Birds estimate of a death toll of about 1000 was probably conservative. Guillemots and Razorbills were affected the most. The effect of the oil spill on the exposed rocky shore was also assessed. (st)

Broman, D. and B. Hjernquist. 1982. Sörsta oljespillet för svenska Östersjön. (The largest oil slick for Sweden's Baltic Sea). Fauna Flora (Stockholm) 77(3):169-176. (in Swedish)

During February 27, 1979, a Russian oil tanker ran aground off Ventpils in Lettland, Sweden and spilled an estimated 5500 tons of oil into the Baltic Sea.

Clean-up operations concentrated first on important nesting grounds, then on areas with high concentrations of birds. A total of 2594 dead birds were collected; another 459 seriously affected birds were shot. Studies on some of the areas affected showed that between 1 and 8 percent of the total number of seabirds in the area died.

The most seriously affected species was the Common Eider (86%). The number of dead birds from this accident was relatively low because the spill happened before the nesting season and the oil floated into small bays without many birds.

The estimated number of oil-related bird deaths for one area of the Stockholm coast in 1977 was 195, the majority of which were Long-tailed Ducks. (st)

Bromley, M. 1985. Wildlife management implications of petroleum exploration and development in wildland environments. Gen. Tech. Rep. Intermt. Res. Stn. No. INT-91. 42 pp.

The impact of the petroleum industry on wildlife populations and habitats is described and means of minimizing and mitigating adverse impacts are presented. A detailed index to an annotated bibliography on impacts is provided. Among the major wildlife groups discussed are waterfowl, shorebirds, raptors, and songbirds. (st)

Brouwer, G.A. 1953. Beiträge zur Frage der Ölpest auf See. (Contribution to the question of oil pollution at sea). Die Vogelwarte 16(4):167-170. (English translation available at Canadian Wildlife Service TR-GER-103).

The victims of oil pollution found along the Dutch coast are almost exclusively marine birds which dive for their food. The losses among these birds, expressed as percentages, amount to: Common Murre (***Uria aalge***) 47%; Razorbill (***Alca torda***) 17%; divers 12% (in particular the Red-throated Diver, (***Gavia stellata***), and to a lesser extent the Black-throated Diver, (***Gavia arctica***); sea ducks 10% (chiefly (***Melanitta nigra***)); gannet (***Sula bassana***) 7%; kittiwake (***Rissa tridactyla***) 5%; and other species 2%. The majority of oiled birds was washed ashore during the winter months (October to April), i.e. during the period when many northern birds are in their wintering ranges on the North Sea. The losses are particularly evident following storms. Data on the increasing world tonnage of oil burning, sea-going vessels from 1914 to 1948 are presented. Progress in the control of oil pollution of the sea through laws and international conventions is reviewed.

Brown, R.G.B. 1973. Seabirds and oil pollution: The investigation of an offshore oil slick. Canadian Wildlife Service Progress Notes (31):1-3.

Many marine oil slicks never come ashore. These are potentially more hazardous to seabirds than those in coastal waters, but it is hard to estimate the hazard, in the absence of counts of dead birds on beaches. This note describes a technique for making such estimates. The drift of the oil, estimated on the basis of wind speed and direction, is compared with the average densities of the seabird species in the area of the slick. This is applied to an oil slick reported on the Grand Banks of Newfoundland, at 44° 41'N 51° 10'W on June 9, 1972. Alcids are the seabirds most vulnerable to oil, but the numbers of Common Murre (***Uria aalge***), the commonest species in the area, are too low for this slick to have created a serious hazard. However, there may have been some mortality in a less vulnerable species, the Greater Shearwater (***Puffinus gravis***). (aa)

Brown, R.G.B., D.I. Gillespie, A.R. Locke, P.A. Pearce and G.H. Watson. 1973. Bird mortality from oil slicks off Eastern Canada, February-April 1970. Canadian Field Naturalist 87:225-234.

Oil slicks resulting from the ***Arrow*** and ***Irving Whale*** spills in February 1970 resulted in the known deaths of 1,500 ducks and seabirds and an estimated total kill of at least 12,000 birds. The species principally affected were Oldsquaws, Red-breasted Mergansers, grebes, and murres in Chedabucto Bay, Nova Scotia; murres, Dovekies, and fulmars between the Nova Scotian coast and Sable Island; and Common Eiders (subspecies ***borealis***), murres, and Black Guillemots off south-east Newfoundland. The breeding and the overall effect of this mortality on the species as a whole is assessed. Only the kill of ***borealis*** eiders approached significance to the population of this subspecies. It is emphasized that the hazard presented by an oil spill depends on its position and timing as much as on its size. (aa)

Buck, W.F.A. and J.G. Harrison. 1967. Some prolonged effects of oil pollution on the Medway Estuary. The Wildfowlers' Association of Great Britain and Ireland. Annual Report and Yearbook 1966-1967:32-33.

The decrease in the peak counts of estuary birds utilizing the Greenborough and Milfordhope Islands and Half Acre Creek which were heavily polluted with oil and treated with emulsifiers, is correlated with the extent of damage to the food requirements of these birds. In these areas great numbers of molluscs, crustaceans, shellfish and finfish died. Extensive areas of ***Enteromorpha*** were destroyed. Waders such as the curlew (***Numenius arquata***), oystercatcher (***Haematopus ostralegus***) and the redshank (***Tringa totanus***) which feed mainly on the surface of intertidal zones, decreased in the range of 88-95%. Turnstones (***Arenaria interpres***) which obtain similar food from higher rocky shores, only decreased by 65%. Brant Geese (***Branta bernicla***) which feed largely on ***Enteromorpha***, decreased by 79-86%. Shelducks (***Tadorna tadorna***), which feed almost exclusively on molluscs (***Hydrobia ulvae***), decreased 97% in the lower intertidal zone and 50% around the higher island saltings. Wigeons (***Anas penelope***), which feed partly on ***Enteromorpha*** but also on brackish grazing marshes, decreased only by 28%. Fish-eating cormorants (***Phalacrocorax carbo***) and Great Crested Grebes (***Podiceps cristatus***) showed no decrease which, indicates that fish quickly repopulated the estuary after the pollution.

***Bulletin of the Army Bird Watch Society**. 1980. 1980(1):7. News from the press. Oil finally kills 700 seabirds.

Burnett, F.L. and D.E. Snyder. 1954. The Blue Crab as starvation food of oiled American Eiders. Auk 71(3):315-316.

The Common (American) Eider (***Somateria mollissima***) wintering off Monomoy Island, Massachusetts, U.S.A. suffered heavy casualty following the breakup of a tanker. The winter flock was reduced to 150,000 ten months later, as compared to 500,000 previous to the incident. No count was made of the complete deaths. Empty gizzards and the lack of adipose deposits in dead eiders revealed that the ducks had suffered from starvation. Blue Crab, not a known food of the eider, was found stuck in the esophagus of two ducks.

Butler, R.G. and P. Lukasiewicz. 1979. A field study of the effect of crude oil on Herring Gull (***Larus argentatus***) chick growth. Auk 96(4):809-812.

The effect of single oral doses (0.2 or 0.5 ml) of weathered South Louisiana crude oil on the growth of Herring Gull chicks raised in the wild was assessed. Chick body weight, culmen length, and middle toe length were recorded at dosing, and at 4- or 8-day intervals following dosing. Observations of chick behaviour were made, and survival to 700 g or 20 days following dosing was recorded. This study provides field confirmation of the inhibitory effects of crude oil ingestion on gull chick growth. Survival among the 0.5 ml-dosed chicks was slightly lower than among control or 0.2 ml birds. Behavioural data for control and treatment groups were not significantly different. (st)

Byrkjedal, I., S. Eldoy and E. Jacobsen. 1982. Oljeskadet sjöfugl langs kysten av Rogaland og Vest-Agder januar - mars 1982. (Oiled seabirds along the coast of S.W. Norway). Var Fuglefauna 5(2):96-99. (in Norwegian with English summary)

During January - March 1982, over 1600 dead seabirds were found along the coast of W. Agder and Rogaland in S.W. Norway during regular beached bird surveys. Several peaks in numbers of oiled birds were reported during the three months and guillemots (incl. 7 British ringed), eider ducks and Little Auks topped the lists. It is possible that some of the eider ducks were killed by an infection of Acanthocephala and not by oil. Analyses of the oil found on the birds show that at least 9 separate sources are involved, all from ships. (as)

California Department of Fish and Game. 1969a. Progress report on wildlife affected by the Santa Barbara Channel oil spill. January 28 - March 31, 1969. Unpublished report. 23 pp.

An estimated loss of 3,600 birds was attributed to the Union Oil well blowout in the Santa Barbara Channel. The number does not include those that perished at sea and whose bodies were not recovered. Loons (*Gavia* spp.) and grebes (*Podiceps* spp. and *Aechmophorus occidentalis*) were the most abundant dead birds. Cormorants (*Phalacrocorax* spp.) and Brown Pelicans (*Pelecanus occidentalis*) were the second most abundant corpses. Aerial surveys indicated that bird numbers in the affected areas remained relatively stable during the 51 day period. Avian population for the 1,075 sq mile area sampled by seven aerial transects was 12,000 birds. Species groupings in order of abundance were gulls, shorebirds, waterfowl, loons and grebes, cormorants, and pelicans and other waterbirds. The birds observed were largely winter visitant and resident species.

California Department of Fish and Game. 1969b. Second progress report on wildlife affected by the Santa Barbara Channel oil spill. April 1 - May 31, 1969. Unpublished report. 9 pp.

Bird losses attributed to the Santa Barbara Channel oil spill have climbed to 3,686. At the end of May 1969, crude oil was still escaping from the ruptured well. Significant bird population movements occurred during this period. A number of wintering species migrated out of the affected area by the end of May, while an influx of pelagic birds, notably the Sooty Shearwater (*Puffinus griseus*) and the Pink-footed Shearwater (*Puffinus creatopus*), was noted offshore. The estimated bird population in the 1,075 sq mile area was 85,000.

Campbell, L. 1980. The impact of an oil spill in the Firth of Forth on Great Crested Grebes. Scottish Birds 11(2):43-48.

As a result of oil pollution in the Firth of Forth in February 1978, 200-241 Great Crested Grebes died. In a survey of the Scottish breeding population in 1978 150-160 pairs were estimated to be present, similar to 1973. There was no evidence that Scottish populations had been affected and it is suggested that most grebes wintering in the Forth were immigrants. (as)

Campbell, L.H., K.T. Standring and C.J. Cadbury. 1978. Firth of Forth oil pollution incident, February 1978. Marine Pollution Bulletin 9(12):335-339.

Where sea ducks and other waterfowl are highly concentrated, even small quantities of oil can be a major hazard. A pollution incident on the Firth of Forth in February 1978 was notable in that it affected 241 Great Crested Grebes (***Podiceps cristatus***) (a high proportion of those present at the time) as well as 700 diving ducks. Evidence is provided indicating that the slick passed close to the main wildfowl feeding area at night, oiling nocturnal-feeding scaup (***Aythya marila***) and pochard (***A. ferina***) and a raft of roosting grebes, while eider (***Somateria mollissima***) and goldeneye (***Bucephala clangula***), which had moved elsewhere to roost, largely escaped. The behaviour of freshly oiled birds is described. Heavily oiled pochard flew 7 km inland to a loch before they were incapacitated. This is the sixth oil pollution incident to affect a large number of birds on the Forth since January 1970. (as)

Camphuysen, C.J. 1981. Olieslachtoffers op de Nederlandse kust, winter 1980/1981. (Oil pollution victims on the Dutch coast, during the winter of 1980/1981). Vogeljaar 29(5):232-238. (in Dutch)

The Dutch oil victim research action group presents results of oiled birds found along the Dutch coast during the 1980-1981 winter. A total of 8185 dead birds were found during 218 counts covering 1270 km of coast. Of those 8185 birds, 3111 were murres, 3723 were other alcids, 1694 were kittiwakes, and 1485 were ***Larus*** gulls. On the basis of those figures, it was estimated that a total of 30,000 birds died along the Dutch coast during the 1980-1981 winter as a result of oil spillage. (st)

Casement, M. 1966. Seabirds avoiding oil patches. Sea Swallow 18:79.

Several flocks of the Aegean species of Manx Shearwaters (***Puffinus puffinus***) flying up the Bosphorus were observed to rise a few feet as the flocks passed over a patch of oil and then swoop down again to within a few feet of the sea.

Cavanaugh, K.P. 1983. The effects of ingested petroleum on some endocrine mechanisms regulating reproductive cyclicity in Mallard ducks. Dissertation Abstracts International B. Science and Engineering 44(6):1728.

Impaired reproductive cyclicity occurs among birds given petroleum-contaminated food, suggesting that altered plasma hormone levels may be responsible for these petroleum-induced changes. To test this hypothesis, the effects of ingested petroleum on physiological and hormonal changes were examined during the successive phases of ovarian maturation, oviposition, and incubation in female Mallard ducks.

The rate of ovarian maturation was slowed significantly when photostimulated ducks were given petroleum-contaminated food. During part of ovarian maturation, plasma concentrations of estradiol, estrone, and progesterone were lower in contaminated birds than in uncontaminated birds.

The ingestion of petroleum changed patterns of oviposition and altered plasma hormone concentrations occurring during the oviposition phase. During the ovulatory cycle, mean daily plasma concentrations of estradiol and estrone were significantly lower in contaminated birds than in controls. Consumption of contaminated food did not affect mean daily plasma progesterone concentrations during the ovulatory cycle. (maa)

Cavanaugh, K.P., A.R. Goldsmith, W.N. Holmes and B.K. Follett. 1983. Effects of ingested petroleum on the plasma prolactin levels during incubation and on the breeding success of paired Mallard ducks. Archives of Environmental Contamination and Toxicology 12(3):335-341.

Mated Mallard ducks consuming food contaminated with South Louisiana crude oil take significantly longer to complete their reproductive cycles than birds given uncontaminated food. This prolongation is due primarily to an abnormally long period of gonadal maturation. The hatchability among eggs incubated by contaminated birds was significantly lower than that of control birds (53% vs. 71%). The group of oil-fed birds produced significantly fewer ducklings per breeding pair than the groups consuming uncontaminated food. Prolactin concentrations increased significantly during the period of oviposition in control females that successfully completed the cycle and hatched live ducklings. This increase continued during the first half of incubation and prolactin concentrations remained high throughout the duration of the incubation phase, dropping sharply at the time of hatching. Contaminated birds showed qualitatively similar patterns of change throughout the cycle; mean concentrations during oviposition and incubation were significantly lower than the corresponding concentrations in control birds. Although the 17 oil-fed females all laid eggs, only 7 showed signs of incubation and 6 of these produced young. The low reproductive success among contaminated birds may be related to the low plasma prolactin concentrations during these phases of the reproductive cycle. (aa)

Cavanaugh, K.P. and W.N. Holmes. 1982. Effects of ingested petroleum on plasma levels of ovarian steroid hormones in photostimulated Mallard ducks. Archives of Environmental Contamination and Toxicology 11:503-508.

Ovarian maturation was slowed significantly when photostimulated Mallard ducks were given petroleum-contaminated food. When they started to lay, oviposition occurred in erratic short sequences interrupted by long anovulatory periods, and eggs were laid during a longer-than-normal interval of the daily light phase. During the ovulatory cycle, mean daily plasma concentrations of estradiol and estrone were significantly lower in contaminated than in uncontaminated birds. Preovulatory variations in plasma estrogen concentration in uncontaminated birds consisted of two maxima separated by a well-defined nadir during mid-phase; no significant cyclical changes occurred in the contaminated birds. Consumption of contaminated food did not affect mean daily plasma progesterone concentrations during the ovulatory cycle. In both groups, preovulatory variations in plasma progesterone consisted of a single peak during the 9-hr period preceding ovulation. During short pauses in egg-laying, mean daily estradiol and estrone concentrations declined significantly in the uncontaminated but not in the contaminated birds. During longer pauses, which occurred only among contaminated birds, plasma concentrations of estradiol and progesterone were both significantly lower than they were during short pauses. (aa)

Chabereck, R.H. 1973. Bird usage of marsh ponds subjected to oil spills. Proceedings of the Louisiana Academy of Science 36:101-110.

Bird populations were inventoried twice monthly over a 2-year period in 3 freshwater marsh ponds with recent oil spills and in 3 unaffected ponds nearby. Soil and water samples were collected at 6-month intervals to determine petroleum levels present. Vegetation and aquatic fauna were also sampled as possible factors affecting bird usage.

The oil spill occurred in July, 1970, and oil concentrations 2 months later averaged 9,076 ppm in affected pond bottoms and 31.7 ppm in the waters, but gradually declined during the study. Controls averaged 411 ppm in bottom material and 4.4 ppm in the water and remained essentially the same throughout the study.

No oil-soaked or dead birds were observed in the study area, however, bird usage of ponds with oil spills was significantly less than that of control ponds for 6 months after the spill. Usage increased after that point in the ponds subjected to oil and remained essentially the same throughout the remainder of the investigation.

Vegetation was killed in 2 of 3 ponds by oil spills and subsequent clean-up operations, but scattered regrowth began the following spring. During the second growing season following the spill, vegetative growth equalled that of the control area. (aa)

Chapdelaine, G. 1980. Onzième inventaire et analyse des fluctuations des populations d'oiseaux marins dans les refuges de la côte nord du Golfe Saint-Laurent. (Eleventh census and analysis of the fluctuations of populations of marine birds in sanctuaries off the north coast of the Gulf of St. Lawrence, Canada). Canadian Field Naturalist 94(1):34-42. (in French with English summary)

The eleventh census of seabirds nesting in the Migratory Bird Sanctuaries of the north shore of the Gulf of St. Lawrence showed that alcid populations continued to decline and larids to increase. Razorbills and puffins showed the most serious decreases while Black-legged Kittiwakes, Ring-billed Gulls, and Common and Arctic Terns increased markedly. The decline of puffins is attributed in part to poaching and human disturbance while Razorbills appear to have decreased owing to oil spills on the wintering grounds and to contamination of the eggs by PCBs. The population growth of the Black-legged Kittiwake can be explained by an abundant food supply, while the increase in Ring-billed Gull, and Common and Arctic Terns is attributed to immigration from non-refuge sites nearby. (aa)

Chapman, B.R. 1981. Effects of the Ixtoc 1 oil spill on Texas shorebird populations. American Petroleum Institute. Proceedings: 1981 Oil Spill Conference. Atlanta, Georgia. American Petroleum Institute Publication No. 4334:461-465.

Oil from the Ixtoc 1 blowout on June 3, 1979, washed ashore in an area where few baseline studies, particularly on bird populations, had ever been conducted, but there was enough time before impact for limited population data to be collected. By the time the oil reached the Texas coast in August, it had been broken up into small mousse pancakes, isolated slicks, or masses of tar balls. As these oil patches washed ashore, the birds were able to adjust their distribution to avoid oiled areas. When the foreshore of the lower Texas coast became covered with oil, shorebirds were forced to occupy poor feeding habitats on the backshore and around rain pools; less than 20 percent of the population remained on the foreshore. Because of the shift in habitat use, few birds were severely oiled. The percentage of total birds with moderately oiled plumage never exceed 10%, but some species were more prone to oiling than others. The behavior of oiled and oil-free birds was compared by time budget methods. Oiled Sanderlings and Willets spent less time feeding and more time resting and engaging in comfort movements.

A series of tropical storms in mid-September cleaned the beaches and reversed the longshore currents. Shorebirds returned to foreshore areas, but not at preimpact densities. Birds continued to avoid areas near tar mats (aggregations of asphaltic oil and shell). (aa)

***Chapman, S.E.** 1970. Oiled gulls in the central North Atlantic. Sea Swallow 21:35.

Chubb, J.C. 1954. Observations on oiled birds, 1951-1953. The Northwestern Naturalist 2:460-461.

A three year study on oiled birds along a mile of seashore shows that species most affected by oil are the divers. The greatest number of oiled birds is washed up on shore during the winter months.

***Clapp, R.B.**, R.C. Banks, D. Morgan-Jacobs and W.A. Hoffman. 1982. Marine birds of the south-eastern United States and Gulf of Mexico. Part 1. Gaviiformes through Pelecaniformes. United States Fish and Wildlife Service. Biological Services Program FWS-OBS 82/01: i-xi, 1-637.

***Clapp, R.B.**, D. Morgan-Jacobs and R.C. Banks. 1982. Marine birds of the south-eastern United States and Gulf of Mexico. Part 2. Anseriformes. United States Fish and Wildlife Service. Biological Services Program FWS-OBS 82/20: i-xiii, 1-491.

***Clapp, R.B.**, D. Morgan-Jacobs and R.C. Banks. 1983. Marine birds of the south-eastern United States and Gulf of Mexico. Part 3. Charadriiformes. United States Fish and Wildlife Service. Biological Services Program FWS-OBS 83/30: i-xvi, 1-853.

Clark, R.B. 1968. Oil pollution and the conservation of seabirds. Proceedings of the International Conference on Oil Pollution of the Sea. 7-9 October 1968. Rome. 76-112.

A review of the literature on oil pollution of birds is given. The effects of oil on bird populations, the rehabilitation of oiled birds, and the problems of conservation are discussed with particular reference to auks.

Clark, R.B. 1970. Oiled Seabird Research Unit. Marine Pollution Bulletin 1(2):22-24.

The Oiled Seabird Research Unit at Newcastle upon Tyne, England, will conduct research on the methods of cleaning oiled birds without destroying the water-repellency of the feathers; the treatmemt of oiled seabirds with energy-rich food, antibiotics, vitamins, and tranquillizing drugs; the treatment of acute enteritis following the ingestion of oil; and the reintegration of rehabilitated birds with a breeding population.

Clark, R.B.** 1973. Impact of chronic and acute oil pollution on seabirds. ***in Background Papers for a Workshop on Inputs, Fates and Effects of Petroleum in the Marine Environment. National Academy of Sciences. Washington D.C. Vol II. 619-634.

Clark, R.B. 1978. Oiled seabird rescue and conservation. Journal of the Fisheries Research Board of Canada 35(5):675-678.

Attempts were made to clean and rehabilitate nearly 8000 oiled birds (mainly auks) following the wreck of the *Torrey Canyon*. This was an almost total failure and a Research Unit on the Rehabilitation of Oiled Seabirds was established in Newcastle upon Tyne to devise effective treatment methods. This has involved a study of the mechanism of water-repellency in seabird plumage and led to the development of cheap, effective cleaning methods and full recovery of the birds within 2-3 wk of capture. These methods have been used successfully on small numbers of birds by amateurs and also operationally on larger numbers by the Research Unit. There have been only few ringing returns but at least some of the cleaned birds became reintegrated with the breeding populations after release. Even with appropriate organization and facilities it is doubtful whether the rescue and treatment of oiled birds can make a material contribution to seabird conservation, but there is often strong public pressure for the treatment of oiled birds and the development of suitable techniques makes this possible. (aa)

Clark, R.B. 1984. Impact of oil pollution on seabirds. Environmental Pollution. Series A: Ecological and Biological 33(1):1-22.

In strictly biological terms, mortality caused by pollution is significant only when it has some impact on the population or community. Continuing losses of seabirds from oil pollution was believed until recently to be responsible for a decline in the population of some species, particularly auks which, because of their population dynamics, appeared unlikely to make good the heavy mortality known to be caused by floating oil. More recent evidence suggests that although southern colonies of auks have declined on both sides of the Atlantic, the cause is probably primarily climatic. Elsewhere in the north-east Atlantic, most auk breeding colonies have increased rapidly in the last decade, despite losses from oil pollution and other causes. This increase has been too rapid and too widespread to be accounted for by natural population growth, but suggests that birds are starting to breed at an earlier age than formerly. It is unrealistic to look for a material reduction of the mortality of seabirds from oil pollution, and preventive, remedial or conservation measures can, at least , have only an extremely localized and trifling impact. Fortunately, although certain risks remain, present evidence suggests that oil pollution is not generally damaging to seabird populations. (aa)

Clark, R.B. and J.P. Croxall. 1972. Rescue operations for oiled seabirds. Marine Pollution Bulletin 3(8):123-127.

Based on the knowledge that feathers lose water-repellency due to absorbed traces of oil, fecal matter or the cleaning agent itself, a new cleaning method for oiled birds has been devised. The method restores the water-repellency of the plumage with the result that most birds can be released within 2-3 weeks of capture. Field trials have given promising results and provided lessons toward the planning of bird rescue operations.

Clark, R.B. and K.G. Gregory. 1971. Feather wetting in cleaned birds. Marine Pollution Bulletin 2(5):78-79.

Preliminary findings indicate that water wetting of feathers in birds previously cleaned of oil by various means is caused by cleaning agent residues present on feathers. Immersion of oiled birds in a hydrocarbon solvent, Arklone P, removes the oil without destroying the water-repellency of plumage. However, this practice is impractical under field conditions as Arklone P vapour is strongly anaesthetic.

Clark, R.B. and R.J. Kennedy. 1968. Rehabilitation of oiled seabirds. Report to the Advisory Committee on Oil Pollution of the Sea. University of Newcastle upon Tyne. 57 pp.

The article gives a selective review of the literature on the aspects of avian biology and physiology relevant to the rehabilitation of seabirds. The problems involved in rehabilitation are reviewed with discussion of lines of research likely to provide knowledge which will increase success. The incidence and distribution of oil pollution, its long-term effect on bird populations, and the effects of oil and emulsifiers on birds are also reviewed.

Clark, R.B. and R.J. Kennedy. 1971. How oiled seabirds are cleaned. Advisory Committee on Oil Pollution of the Sea. Research Unit on the Rehabilitation of Oiled Seabirds. Department of Zoology, University of Newcastle upon Tyne. 48 pp.

The report is largely based on replies to a detailed questionnaire from organizations and individuals regularly engaged in the cleaning and rehabilitation of oiled birds. The report gives some impression of the range of treatments currently in use and suggests the most profitable lines for investigation and experimentation with new methods.

Clark, W.S.** and E. Gorney. 1985. Oil contamination on migrating raptors. ***in Raptor Research Foundation Symposium on the Management of Birds of Prey. International Meeting. Session 10. Second Raptor Research Foundation Conference on Raptor Conservation Techniques. p. 4. (Abstract only)

Clarke, C.H.D., I.N. Gabrielson, B. Kessel, W.B. Robertson, Jr., G.J. Wallace and V.H. Calahane. 1965. Report of the Committee on Bird Protection, 1964. Auk 82(3):487.

Damage by oil pollution to a large nesting colony of Sooty (***Sterna fuscata***) and Noddy Terns (***Anous stolidus***) at Dry Tortugas, Gulf of Mexico, was averted by quick covering of oiled shores with clean fill just days prior to the arrival of the birds.

Clausager, I. 1983. Oil pollution in Danish waters. Ornis Fennica Supplement 3:110-111.

Systematic registration of oil pollution in Danish waters has taken place since World War II. Major oiling incidents occurred in the Wadden Sea and Kattegat and a peak was reached in 1972 when two disasters killed 26,000 and 30,000 birds. No other major disasters were registered until January 1979 when a Swedish tanker grounded in southern Kattegat and spilled about 500 t of heavy fuel oil. Approximately 50,000 birds were oiled in this, the worst spill in Danish waters. Thirty-eight species were affected. Eiders (***Somateria mollissima***) accounted for the majority of oiled birds (60%), followed by Common Scoters (***Melanitta nigra***) (12%), Velvet Scoters (***Melanitta fusca***) (10%), and Red-breasted Mergansers (***Mergus serrator***) (6%). Losses of Red-breasted Mergansers and Velvet Scoters accounted for 15% and 12%, respectively, of their winter populations. Four to five hundred Red-necked Grebes (***Podiceps grisegena***) were lost. Reports from breeding grounds in eastern Denmark in spring 1979 showed catastrophic decreases in the breeding populations of Red-necked Grebes. Reports from 1980 showed the population had not recovered. Local populations of Black Guillemots (***Cepphus grylle***) suffered a 60% decrease in the number of breeding pairs on the island of Hesselö in 1979. (st)

Clotouche, E. and P. Schaeken. 1982. L'accident petrolier survenu en Basse-Meuse liegeoise en 1981 et son impact sur l'avifaune. (Mineral oil pollution on the Dutch-Belgian Maas River: Impact on bird resort and population). Aves 19(1):47-57. (in French with English summary)

On December 8th, 1981, an accident involving an oil barge crossing the Belgian industrial city of Liège, resulted in pollution of the Dutch-Belgian river. An evaluation was made of the damage to the wintering avifauna; though scarcely 100 tons of fuel were spilled, a good 3,000 birds were severely hit on the 50 kilometers downstream. (mas)

Cole, S.D. 1929. Oil pollution. Royal Society for the Protection of Birds. Annual Report 1929:37-40.

The persistent problem of oil pollution and oiled birds in British waters is attributed to the discharge of oily waste into the sea from ships outside the prohibited zones. The equivalent of 500,000 barrels of oil is discharged annually into the sea. Installation of oil-water separators in ships is considered the only effective means of preventing oil pollution of the sea.

Cole, S.D. 1934. The oil pollution menace; a review of the position. Proceedings of the International Ornithological Congress. Oxford. 8:698-701.

Oil pollution has been a serious menace to industry, property, seaside amenities as well as to bird life. To date, the only attempt made to deal internationally with the problem is the 1926 Conference in Washington, U.S.A. where it was recommended that oil discharges should not take place within 50 miles of land. This was not expected to solve the problem as currents carry discharges in the seas onto shores. The only cure seen is the prohibition of discharges at sea and the installation of separators aboard oil-driven ships and tankers.

Conan, G. 1982. The long-term effects of the ***Amoco Cadiz*** oil spill. Philosophical Transactions of the Royal Society of London, B. Biological Science 297(1087):323-334.

The wreck of the supertanker ***Amoco Cadiz*** on the coast of northern Brittany in April 1978 resulted in a spill of 223,000 t of crude oil. Three hundred and sixty km of rocky or sandy shores, salt marshes, and estuaries were polluted. It is estimated that between 15,000 and 20,000 seabirds were killed. The Alcidae were most heavily stressed. Negative trends in the puffin population were enhanced by the spill. Up to 60 years may be necessary for seabird populations to retrieve their stable age distributions. (st)

Conder, P. 1968. To clean or kill. Birds 2:56.

Of the nearly 8,000 oiled birds rescued after the ***Torrey Canyon*** disaster, only 100-150 recovered sufficiently to be released back to the sea. Of these, 60 were ringed before release and within a month 16 were found dead. There is no evidence whether others are alive or dead. With such dismal failure, research into the cleaning and rehabilitation of oiled birds is badly needed.

*__Connors, P.G.__ and S. Gelman. 1980. Red Phalarope responses to thin oil films in foraging experiments. Bulletin of the Wader Study Group. No. 28:44.

*__Conway, C.A.__ 1974. Care and treatment of oiled ducks recovered from the Delaware River in early 1974. Delmarva Ornithol. 9(2):31-37.

Coon, N.C., P.H. Albers and R.C. Szaro. 1979. No. 2 fuel oil decreases embryonic survival of Great Black-backed Gulls. Bulletin of Environmental Contamination and Toxicology 21:152-156.

Eggs from Great Black-backed Gull colonies were externally contaminated with 5 or 20 µl of No. 2 fuel oil. In one colony, clutches treated with 20 µl of oil per egg had significantly poorer survival at 8 days post-treatment than did control clutches. Survival rate did not differ between control and 5 µl-treated clutches. Both the 5 and 20 µl applications significantly reduced hatchability of artificially incubated eggs. Results support earlier conclusions that hatchability of oil-treated eggs increases as the age of the embryo at treatment increases. (st)

Cooper, J. 1971. The Jackass Penguin. Marine Pollution Bulletin 2(4):52.

Following the grounding of the tanker ***Kazimah*** in Table Bay, South Africa, crude oil sludge from its ruptured tanks was released. A total of 559 oiled birds attributed to this spill were received at the rescue station. At the time of writing, nearly two months after the accident, about a third of the birds had died, a third had been rehabilitated and the remainder were still under care.

*__Cooper, J.__ 1978. Effect of oiling from Pantelis a Lemos on seabirds. Cormorant 4:33-34.

Corkhill, P. 1973. Oiled seabirds successfully cleaning their plumage. British Birds 66(12):535-537.

Observations of oiled Great Black-backed Gulls (***Larus marinus***), guillemots (***Uria aalge***), and Razorbills (***Alca torda***) successfully cleaning their plumage are presented. The bird's breeding biology apparently is not disrupted if the oil is removed before egg-laying. (st)

Cowan, E. 1968. The *Torrey Canyon* disaster. *in* E. Cowan. Oil and Water. J.B. Lippincott Co. New York. 157-161.

An account is given of the efforts of various organizations attempting to rescue and rehabilitate oiled birds from the *Torrey Canyon* disaster. Mortality figures and species affected are given.

Cowell, E.B. 1976. Oil pollution of the sea. *in* R. Johnston (ed.). Marine Pollution. Academic Press. London. 353-401.

The history of marine oil pollution is outlined. Studies of auks killed by oiling showed a loss of subcutaneous and visceral fats. The kidneys, intestines, and respiratory tract were affected the most of all organs. Gut contents yielded no highly pathogenic organisms. Toxicity increases from paraffins, naphthalenes, and olefins to the aromatics. (st)

Crocker, A.D., J. Cronshaw and W.N. Holmes. 1974. The effect of crude oil on intestinal absorption in ducklings (*Anas platyrhynchos*). Environmental Pollution 7(3):165-177.

The rates at which water and Na$^+$ are transported across the intestinal mucosa increase when ducklings are transferred from freshwater to a diet containing hypertonic saline drinking water (60% standard seawater equivalent; 264 mM NaCl, 6 mM KCl). These increments in mucosal transfer rates seem to be essential for the successful adaptation of ducklings to hypertonic saline drinking solution. Ducklings given a single oral dose of a crude oil (0.2 ml) at the start of maintenance on hypertonic saline did not develop the characteristic increases in mucosal water and Na$^+$ transfer rates observed in control ducklings 1 and 4 days later. In addition, high mucosal transfer rates which had been developed in ducklings fed hypertonic saline for 3 days were abolished 24 h after the oral administration of 0.2 ml crude oil. Although concentrations of 5 ppm and 20 ppm commercial dispersant in drinking water had no effect on either freshwater- or saline-maintained ducklings, the presence of 12.5-50.0 ppm dispersed crude oil in this solution prevented the development of high mucosal transfer rates in the ducklings given hypertonic saline drinking water. Neither whole nor dispersed crude oil affected the basal mucosal transfer rates of freshwater-maintained ducklings. High mucosal water and Na$^+$ transfer rates are considered necessary to sustain the net uptake of ingested water and electrolytes from the gut of ducklings adapted to hypertonic saline. A diminution of the mucosal transfer rates in seawater-adapted ducklings, through the action of ingested crude oil, may therefore limit the amount of free water available to the organism. Although the high mortality among oil-contaminated seabirds may be due to a variety of pathological conditions, it is postulated that dehydration resulting from impairment of mucosal transfer mechanisms may be an important factor contributing to their death. (aa)

Crocker, A.D., J. Cronshaw and W.N. Holmes. 1975. The effect of several crude oils and some petroleum distillation fractions on intestinal absorption in ducklings (***Anas platyrhynchos***). Environmental Physiology and Biochemistry 5:92-106.

Ducklings given hypertonic saline drinking water show significant increases in the rates of Na^- and water transfer across the intestinal mucosa. These increased rates of transfer are maintained as long as the birds are fed hypertonic saline. Oral administration of a single small dose of crude oil had no effect on the basal rate of mucosal transfer in freshwater-maintained ducklings but the adaptive response of the mucosa is suppressed in birds given hypertonic saline. When crude oils from eight different geographical locations were tested, the degree of inhibition varied between them; the greatest and smallest degrees of inhibition being observed following administration of Kuwait and North Slope, Alaska, crude oils, respectively.

The effects of distillation fractions derived from two chemically different crude oils were also examined. The volume of each distillation fraction administered corresponded to its relative abundance in the crude oil from which it was derived. The inhibitory effect was not associated exclusively with the same distillation fractions from each oil. A highly naphthenic crude oil from the San Joaquin Valley, California, showed the greatest inhibitory activity in the least abundant (2%), low boiling point (<245°C) fraction and the least inhibitory activity in the highest boiling point (>482°C) most abundant (47%) fraction. In contrast, a highly paraffinic crude oil from Paradox Basin, Utah, showed the greatest inhibitory effect with the highest boiling point fraction and a minimal effect with the lowest boiling point fraction; the relative abundances of these two fractions in the crude oil represented 27 and 28%, respectively.

Water-soluble extracts of both crude oils also had inhibitory effects on mucosal transfer rates and these were roughly proportionate to the inhibitory potency of the low boiling point fraction of each oil. Weathered samples of San Joaquin Valley, California and Paradox Basin, Utah, oils showed greater effects than corresponding samples of unweathered oils even though most of the low molecular weight material from both oils was either evaporated or solubilized in the underlying water during the 36-h weathering period. (aa)

Croxall, J. 1979. Birds and oil pollution. ***in*** J.E. Cooper and J.T. Eley. First aid and care of wild birds. David and Charles. Newton Abbot, London and North Pomfret (Vt). 174-191.

The chapter discusses the internal and external effects of oil on birds, the general treatment of oiled birds, capture and pre-cleaning treatment, immediate treatment, subsequent treatment, post-cleaning rehabilitation, ailments of rehabilitating seabirds, and treatment of individual species. (st)

Croxall, J.P. 1975. The effect of oil on nature conservation, especially birds. ***in*** H.A. Cole (ed). Environmental Protection. Applied Science Publishers, Ltd. Barking, Essex. Vol 2. 93-101.

The effect of oil pollution on criteria of basic importance to nature conservation is briefly reviewed. It is concluded that, in general, the overall effects on species diversity and abundance are slight, but rare, local and certain unavoidably high-risk species may be endangered, especially from chronic pollution.

Predominantly, seabirds are threatened in all three categories. The drastic external and internal effects of oil on birds is detailed and behavioural and ecological reasons for certain species, chiefly auk and sea duck being mainly at risk, are outlined.

Data from seabird deaths in oiling incidents and annually through chronic oil pollution show sea ducks and auks to be the important victims. The effect of this scale of mortality is of particular significance for southern colonies of auks, many of them in the British Isles.

Four conservation strategies for seabirds are recognized. These are reducing exposure to oil (through scaring devices and appropriate action for oil slicks), improving facilities for implementation of proven cleaning and rehabilitation techniques, research to discover ways of increasing reproductive success and minimizing other environmental hazards, and breeding in captivity. (as)

Croxall, J.P. 1977. The effects of oil on seabirds. Rapp P-v Réun. Cons. int. Explor. Mer. (171):191-195. International Commission - Scientific Exploration of the Mediterranean Sea.

Seabirds are not only the most obvious victims of oil pollution but perhaps the only group where oil pollution may pose a survival threat. The external effect of oil in destroying plumage waterproofing is detailed and the state of knowledge of the direct and indirect internal effects of crude and fuel oils reviewed, inevitably in rather general terms. The need for more precise information on the behaviour of oil slicks and oil/dispersant mixtures and films at sea is emphasised in relation to potential techniques and strategies for minimising the high risk to seabirds (whether at breeding colonies or on wintering grounds) from oil slicks. (aa)

***Crummett, J.G.** 1973. A study of bird repelling techniques for use during oil spills. American Petroleum Institute (mimeo). New York.

Currie, A. 1975. Oil pollution in the Cromarty Firth. Marine Pollution Bulletin 5(8):118-119.

Cromarty Firth on the north-east coast of Scotland is an area of international importance to wildfowl, and the whole area has been designated a 'Site of Special Scientific Importance' by the Nature Conservancy Council. There are proposals to establish National Nature Reserves in two bays in the Firth. The area has also become a centre of activity for the oil industry exploiting the North Sea oilfield. Repeated oil spillages are threatening the conservation value of the area and unless strong measures are taken to reduce and treat oil pollution from all sources, there could be enormous damage to wildlife. (as)

Curry-Lindahl, K. 1960. Serious situation with regard to Swedish populations of the Long-tailed Duck (***Clangula hyemalis***). International Waterfowl Research Bureau Newsletter (10):15-18.

During the decade from 1950-1960, frequent catastrophes caused by oil pollution in the Baltic have had a devastating effect on the wintering seabirds. The majority of the oiled birds found along Swedish coasts have been Long-tailed Ducks (***Clangula hyemalis***). As this species has greatly decreased in their wintering quarters as well as in their breeding grounds in Swedish mountain lakes, it was proposed that total protection be given to these ducks, and that oil discharge in the Baltic area be prohibited. It was observed that flying flocks of Longtailed Ducks very often swoop down on patches of oil where the deep-sea roll is less heavy. These oil spots serve as veritable deathtraps.

***Curtis, W.F.** 1970. Observations during oil fuel clearing operations following the sinking of the R.F.A. Ennerdale off Mamelle Island in the Seychelle group. Sea Swallow 21:35.

De Beaufort, F. 1967. Représentation de la rupture d'une chaîne biologique. (Display of the break of the biological chain). L'Homme et L'Oiseau (9):14. (English translation available as Canadian Wildlife Service TR-FR-37).

The impact of the oil pollution from the ***Torrey Canyon*** on the marine environment in Brittany will be reconstructed for display. The diorama will show healthy birds in their natural environment and oiled birds in their tragic reality.

Dedera, D. 1971. Water birds of the West. Humble Way 10(4):3-8.

The Santa Barbara Channel oil spill in 1969 and the oil spill in San Francisco Bay in 1971 are briefly reviewed. The organizations involved in cleaning and rehabilitating oiled birds are mentioned.

Dein, F.J. and L.S. Frink. 1983. Treatment and management of oil contaminated birds. Annual Proceedings. American Association of Zoo Veterinarians. 1983:123-126.

The rehabilitation of oil-contaminated birds is a complex procedure, which needs to be tailored to the species of bird and type of oil involved. Trained volunteers' help is essential to the efficient operation of a cleaning center. This paper offers a broad overview of the effects of oil on birds and the cleaning and rehabilitation process. Hopefully, it can serve as a basic guide for those who become involved with the aftermath of a major oil spill. (ac)

De Jager, S. and T. Belterman. 1970. Treatment of oiled eider duck in Holland. Marine Pollution Bulletin 1(10):156-157.

Of the 1,182 oiled Common Eiders (***Somateria mollissima***) rescued in an oil pollution incident off the island of Terschelling, 864 died before, during or immediately after cleaning. "Cleano-sol" was found unsuitable for cleaning due to its toxicity. An additional 1,600 eiders were rescued and left uncleaned; 34 of these survived. The surviving birds were housed on sawdust which effectively removed the oil from the uncleaned birds in two weeks. Antibiotics and vitamin supplements were administered. "Delvocoat" and "Pimaricine" were found effective against aspergillosis. Cockles and mussels were the ideal diet foods but pellets were found adequate as a substitute. The availability of salt water was found indispensable to the rehabilitation as it restored the birds to their natural behaviour. Moulting took its normal course and release was planned, but an epidemic of stomach worms ***Amidostomum*** killed all the surviving birds after being in captivity for seven months.

***Delsaut, M.**, J.L. Dujardin and J. Godin. 1970. Décompte d'oiseaux mazoutés du 27 Mars 1970 au Cap Gris-Nez. (Losses of oiled birds on 27 March 1970 at the Gris-Nez Cape). Le Héron 3:17-18.

De Ridder, M. 1961. Victimes ailées du mazout. (Winged victims of fuel oil). Les Naturalistes Belges 42:145-156. (English translation available as Canadian Wildlife Service TR-FR-32).

A beached bird survey of birds found along the Belgian coast from 1954 to 1960 revealed that kittiwakes (***Rissa tridactyla***), Black Scoters (***Melanitta nigra***), Razorbills (***Alca torda***) and Common Murres (***Uria aalge***) were the most numerous victims of oil pollution.

De Roos, G.T. 1978. Noordse pijlstormvogel als olieslachtoffer op Vlieland. (A North Sea Manx Shearwater as an oil slick victim on Vlieland). Levende Natuur 81(5):238-239. (in Dutch)

During a count of oiled birds, an oiled Manx Shearwater was found on a beach on Vlieland. This is the first record of this species occurring on Vlieland. (st)

Desmet, S. and A. van Dycklan. 1976. Waar gaat het heen met onze vogels? (What is the future of our birds?) Vogeljaar 24(1):2. (in Dutch)

The author talks about the destruction of birds and natural areas. Many oiled birds are found in Dutch bird sanctuaries. (st)

***de Waele, G.** 1981. (Oil slick victims). Veldornitologisch Tijdschr. 4(1):35-36. (in Dutch with English summary)

Diederich, J. 1981. Nur eine kleine Ölpest. (Just a little oil spill). Regulus 15(4):132. (in German)

On March 23, 1979, oiled seabirds were found on the beach at Varangerfjord, north Norway. The few that were still alive were humanely killed. Since there was no trace of oil on the coast, the sea was searched from the air. Only two or three small puddles of oil were seen.

More than 5000 birds washed up on the shore - of these, 1616 could be identified. The numbers of birds oiled were as follows: 1477 Thick-billed Murre (***Uria lomvia***), , 52 Atlantic Puffin (***Fratercula arctica***), 40 Common Murre (***Uria aalge***), 15 King Eider (***Somateria spectabilis***), 14 Common Eider (***Somateria mollissima***), 5 Steller's Eider (***Polysticta stelleri***), 4 Razorbill (***Alca torda***), 3 Oldsquaw (***Clangula hyemalis***), 3 Black Guillemot (***Cepphus grylle***), 2 Red-breasted Merganser (***Mergus serrator***). Of the oiled birds identified, 97.5% belonged to the Alcidae. (st)

***Dieter, M.P.** 1976. The effects of petroleum hydrocarbons on aquatic birds. *in* Sources, Effects, and Sinks of Hydrocarbons in the Aquatic Environment. Proceedings of a Symposium. American University. Washington, D.C. 437-444.

***Dieter, M.P.** 1977. Acute and chronic studies with waterfowl exposed to petroleum hydrocarbons. *in* C. Hall and W. Preston (eds.). Program Review Proceedings of Environmental Effects of Energy/Related Activities on Marine/Estuarine Ecosystems. EPA-60017-77-111. Environmental Protection Agency. Washington, D.C. p. 35.

Dixon, T. and T. Dixon. 1971. The *Panther* affair. Marine Pollution Bulletin 2(7):107-108.

Light seabird casualties occurred after a severe shore oil pollution following the grounding of oil tanker *Panther* off the coast of Kent, U.K. Herring Gulls (*Larus argentatus*), Black-headed Gulls (*Larus ridibundus*) and Fulmar Petrels (*Fulmarus glacialis*) were seen to be oiled but still in flight. Explanation is put forward for the light casualties.

Dixon, T.J. and T.R. Dixon. 1976. *Olympic Alliance* oil spillage. Marine Pollution Bulletin 7(5):86-90.

On November 12, 1975 the Leander class frigate *HMS Achilles* and the Panamanian owned, Liberian registered supertanker *Olympic Alliance* collided in the Dover Strait. The tanker lost an estimated 2000-3000 tonnes of light Iranian crude oil, forming a slick 11.3 km long and 1.6 km wide. The tanker was still leaking oil when it left the collision site; by the time it reached Wilhelmshaven an additional 10,000 tonnes of oil had escaped. Estimates of the numbers and species of oiled seabirds were made. Auks (Alcidae) were the most frequently recorded victims. The resident, non-breeding cormorant (*Phalacrocorax carbo*) population was particularly affected. Some unexpected oiled species included a Brant (*Branta bernicla*), Tufted Duck (*Aythya fuliqula*) and coot (*Fulica atra*). (st)

***Dolensek, E.P.** and J. Bell. 1977. Help! A step-by-step manual for the care and treatment of oil-damaged birds. Animal Kingdom 80(4)(Suppl.)AK 2-AK 39.

***Dolensek, E.P.** and J. Bell. 1979. Help! A step-by-step manual for the care and treatment of oil-damaged birds. New York Zoological Society. 39 pp.

***Donaldson, E.** 1979. Oil pollution of the sea and its associated problems. Report Copeland Bird Obs. 1978:21-24.

Dow, D.D. 1983. The effects of a minor oil spill on seabirds at Caloundra, Queensland. Australian Bird Watcher 10(1):15-18.

On October 29, 1981 the *Anro Asia* ran aground on the north tip of Bribie Island off the coastal town of Caloundra. On October 31 and November 1, fuel oil was reported leaking from a ruptured compartment. Oiled birds observed after the spill included Australian Pelicans (***Pelecanus conspicillatus***) and Pied Cormorants (***Phalacrocorax varius***). (st)

Drinkwater, B.**, M. Leonard and S. Black. 1971. Santa Barbara's oiled birds. ***in D. Straughan (ed.). Biological and Oceanographical Survey of the Santa Barbara Channel Oil Spill 1969-1970. Vol. 1. Biology and Bacteriology. Allan Hancock Foundation. Los Angeles, California. 313-324.

Drost, R. 1959. Oil pollution on the coasts of the German Federal Republic. Proceedings of the International Conference on Oil Pollution of the Sea. 3-4 July 1959. Copenhagen. 73-75.

Observations between January 1957 and March 1959 in the North Sea show no reduction in the amount of oil floating on the surface in spite of the Convention of 1954, which became effective on July 26, 1958, prohibiting the discharge of oil and oil wastes in certain agreed zones. Reports of fouled beaches indicate oil pollution is still a problem. Reports on the number of dead oiled birds washed ashore show a decrease in 1957 and 1958 but an increase in 1959.

Dubrovsky, A. 1959. Ptitsy gibnut v nefti. (Birds perish in oil). Okhota i Okhotnich'e Khozyaistvo 13(4):58. (English translation available as Canadian Wildlife Service TR-RUS-281).

In Ukhta, Komi, USSR, countless numbers of migrating ducks and geese perished in an open oil reservoir with a surface area of over 500 m^2 during its 5 years of existence.

Duffy, D.C. 1977. Oil contamination on breeding Common Terns. Bird - Banding 48(4):370-371.

Data is presented on the extent of oil tar contamination of breeding Common Terns (***Sterna hirundo***) on Great Gull Island (at the mouth of Long Island Sound between New York and Connecticut) from 1973 to 1976. Oiling was infrequent; only in 1974 were more than one percent of birds oiled. It should be noted that severely oiled birds may not have bred, and thus, would not have been examined. Oiled birds could also have moulted their oiled plumage on the wintering grounds. (st)

***Du Mont, P.G.** 1977. Oiled birds at Ocean City, Maryland. Maryland Birdlife 33(1):12-13.

Duncombe, F. 1983. Mysterieuse marée noire sur les côtes Normandes. (Mysterious black tide on the Normandy coast). Le Courrier de la Nature. No. 84:7-9. (in French)

A spill on the Normandy coast in January oiled 5000 birds. The public was not informed of the spill since the news media were preoccupied with election coverage, and no beaches, cliffs, or seaports were affected. Ninety percent of the victims were alcids, of which ¾ were guillemots and ¼ were auks. Of 700 live birds collected, 400 died in the first few days. Three hundred were cleaned, but 120 died before release. Of the 180 birds released, about 150 apparently survived. Although the cleaning methods used have been perfected, medical treatment techniques need to be developed. (st)

Dunnet, G.M. 1982. Oil pollution and seabird populations. Philosophical Transactions of the Royal Society of London (B) 297(1087):413-427.

Oiling incidents have given rise to a great deal of public concern about the effect of oil pollution on the well-being of seabird populations. It is important to determine if the observed mortality from oiling is substantial and additional in relation to the natural mortality.

Most seabirds are long-lived, with low mean annual adult mortality rates, and many of them do not breed until they are several years old. Using results from beached bird surveys and ringing recoveries, an attempt is made to relate the numbers of birds found dead, and the numbers oiled, to the numbers that might be expected to die according to the measured rates of annual mortality. It seems that in western European waters the numbers killed by oil pollution is in tens of thousands per winter on average, while the number expected to die naturally is in hundreds of thousands per year. It is not known whether or not oil-induced mortality is additional to natural mortality. It is also pointed out that current environmental circumstances seem favourable and that the present resilience of populations may not persist if conditions change.

Emphasis is placed on the very large numbers of pre-breeding birds and the need for information on the means by which they are recruited to breeding colonies. (maa)

Eagles, D. 1964. Oil pollution - A near disaster for the Greater Snow Goose. Canadian Audubon 26(2):37-39.

Prompt cleanup of oil on the staging area before the arrival of the geese at Cap Tourmente marshes, Quebec, Canada, saved the world's remaining 70,000 Greater Snow Geese (***Chen caerulescens atlantica***) from disaster.

Eastin, W.C., Jr. 1979. Methods used at Patuxent Wildlife Research Center to study the effects of oil on birds. ***in*** C.H. Brown (ed.). Proceedings of the 1979 United States Fish and Wildlife Service. Pollution Response Workshop. 60-66.

Experiments with Mallard ducks (***Anas platyrhynchos***) revealed components of ingested oil accumulated more in fat than in other tissues. Oil-treated eggs showed two distinct periods of high embryo mortality during the developmental stage. Outside of these periods oiling had little effect on embryo survival. The components of crude oil responsible for high mortality rates were trace metals and aromatic hydrocarbon fractions. Chronic ingestion of crude oil may affect reproduction and may lower resistance to other stresses. (st)

Eastin, W.C., Jr.** and D.J. Hoffman. 1978. Biological effects of petroleum on aquatic birds. ***in C.C. Bates (ed.). Proceedings of the Conference on Assessment of Ecological Impacts of Oil Spills. American Institute of Biological Sciences. Washington, D.C.

Eastin, W.C., Jr., D.J. Hoffman and C.T. O'Leary. 1983. Lead accumulation and depression of δ-aminolevulinic acid dehydratase (ALAD) in young birds fed automotive waste oil. Archives of Environmental Contamination and Toxicology 12:31-35.

The effects of a 3-week dietary exposure to automotive waste crankcase oil (WCO) were examined in 1-week-old Mallard (***Anas platyrhynchos***) ducklings and pheasant (***Phasianus colchicus***) chicks. Treatment groups consisted of birds exposed to 0.5, 1.5, or 4.5% WCO, to 4.5% clean crankcase oil (CCO), or untreated controls. In both species, red blood cell ALAD activity was significantly inhibited after one week by 50 to 60% in the 0.5% WCO group and by 85 to 90% in the 4.5% WCO group due to the presence of lead. Growth, hematocrit, and hemoglobin were not significantly affected at the end of three weeks. Plasma aspartate aminotransferase (AST) activity was higher in Mallards after three weeks of ingesting either 4.5% WCO or 4.5% CCO, suggesting an oilrelated effect due to components other than lead. Treatment had no effect on plasma concentration of uric acid, glucose, triglycerides, total protein, or cholesterol. Lead analysis showed the WCO to contain 4,200 ppm Pb and the CCO to contain 2 ppm. Tissues of Mallards were examined for accumulation of lead and the order of accumulation at the end of three weeks was kidney$>$liver$>$blood $\geq$ brain. (aa)

Eastin, W.C., Jr. and B.A. Rattner. 1982. Effect of dispersant and crude oil ingestion on Mallard ducklings (*Anas platyrhynchos*). Bulletin of Environmental Contamination and Toxicology 29:273-278.

The effect of ingested oil dispersant Corexit 9527 on growth and blood chemistries of Mallard ducklings was studied. Ducklings were fed diets of duck starter mash mixed with 0.15% Prudhoe Bay crude oil (PBCO), 0.15% H_2O + 0.015% Corexit 9527, or 0.15% PBCO + 0.015% Corexit 9527. Ducklings were weighed and blood samples were taken over 9 weeks. After hematocrit determinations, blood chemistries were analyzed. Biochemical measurements included glucose, total protein, triglycerides, cholesterol, sodium, and activities of ornithine carbamyl transferase (OCT), and alanine aminotransferase (ALT). Mean body weight, plasma OCT activity, and glucose concentrations did not differ among groups. ALT activity in the dispersant group was elevated in week nine. No other effects of dispersants were observed. Exposure to 0.15% PBCO reduced hematocrit and cholesterol concentration and elevated plasma levels of triglycerides and sodium. When crude oil was fed in combination with dispersant, the dispersant appeared to diminsh some of the toxic effects of the oil. Mallard ducklings can probably ingest low levels of dispersant alone, or in combination with crude oil for nine weeks without marked biochemical indications of toxicity. (st)

*__Ecke, H.__ 1957. Weltproblem Ölpest. (The world problem of oil pollution). Hamburg, Verein Jordsand. Fünfzig Jahre Seevogelschutz 1957:73-84.

Edwards, R.A. 1963. Treatment of 'washed up' penguins. Bokmakerie 15(1):8.

Oil contamination is the most frequent disability encountered among penguins stranded on South African beaches. A method of treatment of these oiled penguins is described. Rest in a warm room is essential until the penguin can withstand de-oiling. Fuller's earth is recommended for cleaning lightly oiled birds while treatment with Fuller's earth followed by washing in diluted Teepol detergent is suggested for the heavily oiled birds. The diet consists of fish sprinkled with pilchard oil. Birds are kept in captivity to convalesce and until natural oil in the feathers is restored. Penguins are ringed before release.

Ellenton, J.A. 1982. Teratogenic activity of aliphatic and aromatic fractions of Prudhoe Bay crude and fuel oil No. 2 in the chicken embryo. Toxicology and Applied Pharmacology 63(2):209-215.

The teratogenic and embryotoxic activities of aliphatic (fraction 1), two- or three-ring aromatic (fraction 3), and four- or five-ring aromatic (fraction 4) fractions of Prudhoe Bay crude oil and fuel oil No. 2 were investigated in the developing chicken embryo. Embryos were treated at 96 h development via the air sac membrane. Treatment with the aliphatic fraction of either oil did not cause any increase in developmental abnormalities; however, it did result in a dose-related significant decrease in weight, crown-rump length, and head length. Fraction 3 of both oils had both teratogenic and embryotoxic activities in the embryos, causing aberrations such as gastroschisis, edema, beak abnormalities, hemorrhages, and limb defects. Fraction 4 of Prudhoe Bay crude caused a slight but insignificant increase in developmental abnormalities while fraction 4 of fuel oil No. 2 had no teratogenic effect at the concentrations tested. (aa)

***Engel, S.E.**, T.E. Roudybush, J.C. Dobbs and C.R. Grau. 1978. Depressed food intake and reduced reproduction in Japanese Quail following a single dose of Prudhoe Bay crude oil. Presented to the 17th Annual Hanford Biology Symposium. October 17-19, 1978.

Environment 13(2):13-21. 1971. Horizon to horizon.

Some oil pollution incidents around the world which occurred during the period November 1969 to January 1971 are reported. Tanker accidents, oil spills from normal shipping operations, blowouts and other forms of oil pollution, and extent of damage and casualties, are discussed.

Erasmus, T., R.M. Randall and B.M. Randall. 1981. Oil pollution, insulation and body temperatures in the Jackass Penguin (***Spheniscus demersus***). Comparative Biochemistry and Physiology A. Comparative Physiology 69A:169-172.

1. Penguins with feathers affected by oil, cleaning detergents, or moulting showed hypothermia in water at 20°C but not in air at the same temperature.
2. Studies on the patterns of the insulation characteristics of aquatic birds should be done not only in air, but also in water because of differences in the thermal neutral range of birds in these media.
3. It is suggested that oil pollution may cause death in aquatic birds by cold exposure in water, but in air, toxic effects may be more important. (aa)

Erasmus, T.** and E.D. Wessels. 1985. Heat production studies on normal and oil-covered Jackass Penguins (Spheniscus demersus***) in air and water. South African Journal of Zoology 20(4):209-212.

Erickson, R.C. 1962. Effects of oil pollution on migratory birds. Transactions of the Seminar on Biological Problems of Water Pollution 3:177-181.

In North America, greatest losses of migratory birds to oil pollution have been observed along the coast and in offshore waters off the Atlantic Ocean and to a lesser extent off the Gulf of Mexico and Pacific Ocean. It has been worse in or adjacent to harbours and oil refineries of the north-east and along the heavily travelled shipping lanes. The direct effect of oil pollution on birds has been its death toll. Birds whose plumage has been soaked in oil become waterlogged and may die by drowning or from exposure to cold or starvation. Indirectly, birds are affected by deposits of oil which reduce the availability of food along shore or on the bottom of shallow water. To obtain a more accurate appraisal of the effects of oil on migratory bird populations, systematic surveillance of sites of chronic and accidental pollution in areas of intensive use by migratory birds must be made. Studies of the short- and long-term effects of oil pollution on plants and animals important to migratory birds must be carried out to assess the impact on the birds' habitat.

Erickson, R.C. 1963a. Oil pollution and migratory birds. Atlantic Naturalist 18(1):5-14.

Same paper as in Erickson (1962).

Erickson, R.C. 1963b. Oil vs. wildlife. Maryland Conservationist 40:2-10.

Oil affects birds directly on contact which results in drowning or exposure to cold and starvation. Little is known about the toxic effects of ingested oil. Indirectly, the birds are affected by contamination of the feeding grounds. Losses through direct oil contamination are greatest when birds are concentrated, as at stopover points or on wintering grounds.

Fisher, J. 1957. The menace of oil pollution. Atlantic Naturalist 12(4):166-169.

The article gives an account of the gravity of the problem of oil pollution, its effect on birds in British and other European countries, and the steps taken in its solution. To date, the main accomplishment towards preventing oil pollution has been the Convention of 1954 in London, which agreed on the main provisions which will prohibit discharge of oil and oily mixtures at sea. The convention has not come into effect, awaiting ratification by 15 countries.

Fisher, J. and S. Charlton. 1967. A tragedy of errors. Audubon 69(6)::72-85.

A description is given of the events prior to the grounding of the ***Torrey Canyon***, the fruitless salvage efforts, the destruction of the tanker by bombs, the massive use of detergents to disperse oil at sea and clean beaches, the destruction of marine organisms and birds, and the attempted rescue and rehabilitation of oiled birds.

Fleming, W.J., L. Sileo and J.C. Franson. 1982. Toxicity of Prudhoe Bay crude oil to Sandhill Cranes. Journal of Wildlife Management 46(2):474-478.

After the Ixtoc I oilwell blowout in summer 1979, wildlife managers were concerned that migrating Whooping Cranes (***Grus americanus***) would encounter massive quantities of oil on their wintering grounds on the Aransas National Wildlife Refuge. To assess the toxicity of oil to Gruidae, Sandhill Cranes (***Grus canadensis tabida***) were dosed daily by esophageal intubation with 0, 2, or 10 ml/kg Prudhoe Bay crude oil, from day 1 through 25. These relatively large quantities of oil caused neither mortality nor hematological or serum chemistry changes. Feather oiling at spill sites is probably a more severe threat to birds than is acute crude oil toxicity. (st)

Folkestad, A.O. 1981. Oljeutslepp ved Runde sommaren 1981. (Oil discharge near Runde in the summer of 1981). Var Fuglefauna 4(3):162-164. (in Norwegian)

Early on June 10, 1981 a report was made of a major oil spill north of the bird breeding colony on the island of Runde. A favourable turn in the weather helped prevent a disaster - few oiled birds were observed. One week later, as the result of eye witness reports, the captain of a Greek cruise ship admitted to discharging oil at Runde, Vik, and Bodö. The lack of preparation, equipment, and organization in dealing with this spill was alarming. (st)

Folkestad, A.O. 1982a. Nokre inntrykk frå oljevernövingar utafor norskekysten 1980-1981. (Impressions from oil clean-up exercises in the North Sea). Var Fuglefauna 5(2):105-107. (in Norwegian with English summary)

The author took part as an observer on three exercises in which small quantities of oil were released into the sea after which attempts were made to clean them up with oil "booms" and skimmers. The author was not impressed with the effectiveness of the equipment, even under such controlled conditions, and doubts whether today's technology can do anything to physically limit the effect of an oil spill on the surface of the sea. (as)

Folkestad, A.O. 1982b. Oljens virkning på fugl. (The effects of oil on birds). Var Fuglefauna 5(2):115-116. (in Norwegian)

Oil causes both external and internal damage to birds. Oil destroys the feathers' waterproofing qualities and leads to a loss of insulation. Impaired mobility, malnutrition, and starvation also result from external oiling. Internal damage occurs when birds ingest oil while preening. Oil poisoning results in lowered resistance to infection, impaired electrolyte balance, dehydration, digestive disturbances, necropsy, and impaired liver and kidney function. Oil transferred from adults to eggs and chicks during incubation and hatching can seriously affect the survival and development of young birds. (st)

***Folkestad, A.O.** 1982c. Seabird mapping in Norway. Var Fuglefauna 5(2):141-142. (in Norwegian)

Folkestad, A.O. 1982d. Vask av oljeskadd sjofugl - er dette verdt innsatsen? (Cleaning oiled birds - is it worth it?). Var Fuglefauna 5(2):122-124.

The problems involved with cleaning and rehabilitating oiled birds are discussed. The author stresses that treating oiled birds is in no way an acceptable solution to the problem of oil pollution and seabirds. Only through research and cooperation can groups on either side of the oil pollution issue work to combat the problems that lead to the destruction of birds. (st)

Ford, R.G., J.A. Wiens, D. Heinemann and G.L. Hunt. 1982. Modelling the sensitivity of colonially breeding marine birds to oil spills: Guillemot and kittiwake populations on the Pribilof Islands, Bering Sea. Journal of Applied Ecology 19(1):1-31.

We develop simulation and analytic models to estimate the responses of colonially breeding marine birds to environmental perturbations such as oil spills occurring within the foraging area of the populations.

Short-term impacts are considered through a demographic sub-model and a foraging sub-model.

Applications of the model to populations of guillemots and kittiwakes breeding on the Pribilof Islands in the Bering Sea are made.

We construct three specific scenarios of oil spills to explore the patterns of population mortality and recovery times projected by the models.

We use a simple population dynamics model in conjunction with the short-term model to estimate the long-term population consequences of both one-time and chronic perturbations.

Our analyses are hampered by a lack of field information on several critical model parameters. These features of seabird biology merit closer attention, and their present uncertainty renders our model projections only general rather than precise. (mas)

Frink, J. and F.J. Dein. 1982. Rehabilitation of Ruddy Ducks contaminated with oil. Journal of the American Veterinary Medicine Association 181(11):1398-1399.

Fifty-six Ruddy Ducks (***Oxyura jamaicencis***) contaminated with No. 6 fuel oil were retrieved from the Delaware River in Philadelphia, Pennsylvania on August 5-6, 1980 and transported to rehabilitation facilities. All birds were tube-fed with a hydrating solution. Eighteen birds received injections of dexamethasone, 18 were given pentobarbitol, and 20 received no injections. All ducks were washed with a detergent solution, rinsed with fresh water and dried with forced air. Groups of 15 to 20 birds were placed in 1.2 x 2.4 m holding pens with continuous access to water for swimming, dry areas under infrared heat lamps, and food consisting of moistened dog food, fresh greens and minced fish. For two days, birds were tube-fed hydrating solution enriched with high-protein cereal and liquid vitamins. Seventeen ducks died during treatment. There was no significant difference in survivability of birds given dexamethasone, pentobarbital, or no treatment. Survival rate was reduced when cloacal temperatures fell below 40° C or when body weight was less than 0.5 kg. (st)

***Frink, L.S.** 1982. A new approach to oiled bird rehabilitation after oil spills on the east coast (USA). *in* P.J. Rand (ed.). Land and Water Issues Related to Energy Development. Proceedings of the 4th Annual Meeting of the International Society of Petroleum Industry Biologists. 22-25 September, 1981. Denver, Colorado. Ann Arbor Science Publishers. Woburn, Massachusetts. 257-262.

Fritze, E. 1976. Druknet olieindsmurt Trane. (Drowned, oil-covered crane). Feltornithologen 18(1):38. (in Danish)

A dead oil-covered adult crane was found almost buried in seaweed on the coast. The bird probably encountered an oil slick at sea and was blown ashore. Judging by its appearance, the bird had been dead for three or four days. Relatively few dead cranes had previously been encountered in Denmark. (st)

Frostrup, J.C. 1979. The Mute Swan (*Cygnus olor*) in Aust-Agder, Norway. Fauna (Oslo) 32(4):161-165.

Mute Swans were first recorded as breeding in Aust-Agder in the summer of 1973. At that time, one pair of adults and 5 pulli were found. By the end of the 1979 breeding season a total of 120 swans was recorded. Death from oil pollution or collisions with electricity powerlines claimed 28 swans in the last two years. (st)

***Frostrup, J.C.** 1982. Death of the Mute Swan in Norway. Fauna (Oslo) 35(1):36-39. (in Norwegian with English summary)

***Fry, D.M.**, L. Addiego, S. Schwarzbach and C.R. Grau. 1985. Hematological effects of Bunker C fuel oil on Common Murres. Colonial Waterbird Group Newsletter 9(3):29. (Abstract only).

Fry, D.M., R. Boekelheide, J. Swenson, A. Kang, J. Young, and C.R. Grau. 1985. Long-term responses of breeding seabirds to oil exposure. Pacific Seabird Group Bulletin 12(1):22.

A multi-year study of breeding birds exposed to a small quantity of oil has demonstrated reduction in breeding success and switching of breeding sites in a subsequent year. Breeding success of Wedge-tailed Shearwaters and Cassin's Auklets was reduced by external application of 0.1 to 2.0 ml weathered Santa Barbara crude oil. Abandonment and switching of burrows, and switching of mates were contributors to lowered success. Abandonment was more pronounced in marginal breeding habitat, and breeding failure in one year influenced mate fidelity and return to the same burrow in a subsequent year. The effects of oil appear to be complex, with disruption of breeding occurring as a consequence of the toxic effects plus additional indirect effects from disruption of pair bonds following breeding failure. (ct)

Fry, D.M. and L.J. Lowenstine. 1982. Insults to alcids: Injuries caused by food, by burrowing, and by oil contamination. Pacific Seabird Group Bulletin 9(2):78-79.

Oil-contaminated Cassin's Auklets exhibited dissociation of liver cells and oiled auklets and Common Murres showed necrosis of kidney tubules. Hematocrits were variably depressed in oiled birds with packed cell volumes as low as 15-21%. No differences were observed in the adrenal glands or salt glands of oiled and control birds. (mas)

Fry, D.M. and L.J. Lowenstine. 1985. Pathology of Common Murres and Cassin's Auklets exposed to oil. Archives of Environmental Contamination and Toxicology 14(6):725-737.

The histopathology of diving seabirds exposed to oil is described. Cassin's Auklets (***Ptychoramphus aleuticus***) were experimentally exposed to weathered Santa Barbara Channel (CA) crude oil by external application to the breast plumage or wings. Beached Common Murres (***Uria aalge***) were recovered from an accidental oil spill of Bunker C fuel oil. Exposed birds exhibited hepatocellular dissociation and hemosiderosis, renal tubular necrosis, and hemolytic anemia. Both unexposed and exposed birds exhibited numerous gastrointestinal lesions and parasites making interpretation of oil damage effects to the gastrointestinal system difficult. Burrow nesting auklets had a high incidence of pneumoconiosis while cliff nesting murres had no particulate inclusions on lungs. The results describe the extent of pathology to be expected in wild, free living seabirds. (aa)

Fry, D.M., J. Swenson, L.A. Addiego, C.R. Grau and A. Kang. 1986. Reduced reproduction of Wedge-tailed Shearwaters exposed to weathered Santa Barbara crude oil. Archives of Environmental Contamination and Toxicology. 15(4):453-463.

Wedge-tailed Shearwaters breeding on Manana Island, Hawaii were treated with 0.1-2.0 ml weathered Santa Barbara crude oil either by external application to the breast plumage or by oral dose in gelatin capsules approximately 30 days prior to egg laying. Applications of oil caused reduced lay, lowered hatching success, and reduced breeding success. Two ml applied externally to the breast plumage resulted in a greatly reduced number of eggs laid and complete hatching failure of 60 pair of exposed birds. Oral doses of oil in gelatin capsules reduced laying and breeding success, but to a lesser extent than external exposure. Oil exposure did not change the length of the prelaying exodus or cause birds to move to new areas of the breeding colony, but resulted in abandonment and reduced incubation attentiveness. Growth rates of chicks of oral dosed birds were not different from controls, although survival of chicks of dosed birds was reduced. Long-term effects of external application of 2.0 ml of oil were demonstrated by a decreased number of birds returning to the colony in the year after dosing and reduced breeding success one year after oil exposure. (aa)

***Gallo, N.** 1977. Oil spills and Oregon's birds. Oregon Birds. No. 1:2-8.

Gay, M.L., A.A. Belisle and J.F. Patton. 1980. Quantification of petroleum-type hydrocarbons in avian tissue. Journal of Chromatography: International Journal of Chromatography, Electrophoresis and Related Materials 187:153-160.

Methods were developed for the analysis of 16 hydrocarbons in avian tissue. Mechanical extraction with pentane was followed by clean-up on Florisil and Silicar. Residues were determined by gas-liquid chromatography and gas-liquid chromatography-mass spectrometry. The method was applied to the analysis of liver, kidney, fat, and brain tissue of Mallard ducks (***Anas platyrhynchos***) fed a mixture of hydrocarbons. Measurable concentrations of all compounds analyzed were present in all tissues except the brain. Highest concentration were in fat. (as)

Gibson, R. 1966. Oil pollution and its effects on birds in south-east Kent. Seabird Bulletin 2:67-69.

The results of the beach surveys of oiled birds during the winters of 1963-1966 are given. The regular surveys were carried out on the beaches at Dover and a ten-mile stretch of coast from Kingsdown to the point at Sandwich. It is the author's belief that death as a direct result of external oiling is rarely the case, but is rather due to the internal effect of the oil.

Giles, L.A., Jr., and J. Livingston. 1960. Oil pollution of the seas. Transactions of the North American Wildlife Conference 25:297-303.

The focal point of oil pollution on the North American coast is Newfoundland. Pollution originates from ships using the heavily travelled North Altantic routes. Virtually all species of North Atlantic seabirds are affected, with murres and Razorbilled Auks (***Alca torda***) suffering the heaviest toll.

Gochfeld, M. 1979. Prevalence of oiled plumage of terns and skimmers on western Long Island, New York: Baseline data prior to petroleum exploration. Environmental Pollution 20(2):123-130.

Observations at Long Island seabird colonies during the period 1969 to 1978 revealed a more or less constant prevalence of oiling of less than 1% for adult Common Terns and nearly 2% for adult Black Skimmers. Oiling was usually light (1-2 on a scale of 5) and very few heavily oiled birds were seen either at the colonies or elsewhere on Long Island's beaches. Currently, oiling of seabirds on the Altantic Coast of North America is not a widespread or serious problem compared with its prevalence on parts of the Pacific and Gulf Coast of North America and in Europe. Data presented here provide a baseline for comparison with future years, since oil exploration began off Long Island during 1978 and large-scale exploitation is planned. (aa)

***Goethe, F.** 1954. Deutscher Ölpestbericht 1952. (German oil pollution report for 1952). Nachrichtenblatt Naturschutz und Landschaftspflege 25:1-3.

***Goethe, F.** 1956. 1st die Rettung von Seevögeln möglich? (Is it feasible to rescue seabirds from oiling?). Wild und Hund. 59:243-244.

Goethe, F. 1961. Deutscher Ölpestbericht 1953-1961. (German oil pollution report 1953-1961). Internationaler Rat für Vogelschutz. Deutsche Sektion. Berich Nr. 1:50-61. (English translation available as Canadian Wildlife Service TR-GER-102)

Incidents of oil pollution along the German coasts are reviewed for the 1953-1961 period. The numbers of oiled birds, counted or estimated dead, are 11,859, 1,104, 6,274, 524, 128, 136, 486, 943 and 345 for the years 1953 to 1961 respectively. The Black Scoters (***Melanitta nigra***) were worst hit followed by eiders (***Somateria mollissima***) and Common Murres (***Uria aalge***). A catastrophic loss of game birds estimated at 14,132 individuals (most of which were dabbling ducks) occurred in 1959 when oil was spilled into the lower Weser River.

***Goethe, F.** 1966. Gedanken über eine verhinderte Seevogelkatastrophe. (Thoughts on a seabird catastrophe averted). Jahreschr. B.-d. Vogelschutz 1966:23-25.

Goethe, F. 1968. The effects of oil pollution on marine and coastal birds. Helgolander Wissenschaftliche Meeresuntersuchungen 17:370-374.

Oil pollution of the sea, especially damage of oil tankers, may cause severe effects on populations of sea and coastal birds, especially as far as bird aggregations in winter quarters or breeding places are concerned. Examples of oil pollution effects on birds are given and the most severely affected species of European waters are quoted. (aa)

***Goethe, F.** 1978. Pollution of the Wadden Sea area. 4. Effects of pollution. 4. Oil pollution. 2. Bird mortality in the Wadden Sea caused by oil. 2. Oil pollution affecting birds along the German North Sea coast. Report Wadden Sea Working Group. No. 8:58-59.

Gorman, M.L. and H. Milne. 1971. Seasonal changes in the adrenal steroid tissue of the Common Eider (***Somateria mollissima***) and its relation to organic metabolism in normal and oil polluted birds. Ibis 11(2):218-228.

Histological examination of oiled eiders revealed extensive interrenal hyperplasia, the interrenal fractional volumes being significantly higher than those encountered in normal birds at any time of the year. Associated with the interrenal hyperplasia, nuclear diameters were greatly increased and in excess of normal values. The observed interrenal hyperplasia is attributed to the increased activity of the tissue accompanied by catabolism of protein in birds unable to feed. It is doubted that interrenal hyperplasia was due directly to the toxic effects of ingested oil since the corpses had little or no oil in their digestive systems and no obvious signs of inflammation from oil which may have passed through.

Gorman, M.L. and C.E. Simms. 1978. Lack of effect of ingested Forties Field crude oil on avian growth. Marine Pollution Bulletin 9(10):273-276.

The reported cessation of growth by young Herring Gulls dosed with Kuwait and Louisiana crude oil was not observed when chicks of Herring Gull and other birds were dosed with Forties crude oil from the North Sea. One reason for this discrepancy is thought to be that the former birds may already have completed their growth at the time of the experiments. (as)

***Górski, W.** 1975. (Investigations on causes and consequences of oily poisonings of water birds on the Polish sea coast of the Baltic Sea in the years 1969 to 1972). Rocznik Akad. Roln. Poznam. 87:89-106. (in Polish)

Górski, W., B. Jakuczun, C. Nitecki and A. Petryna. 1976. Badania smiertelnosci ptaków wodnych na polskim wybrzezu Baltyku (dane za lata 1970-1974). (Investigations on oil pollution on the Polish coast of the Baltic Sea 1970-1974.) Przeglad Zoologiczny 20(1):81-87. (in Polish with English summary)

The investigations were made on the Polish coast of the Baltic Sea in 1970-1974. The length of explored coast was: in 1970/71 - 18 km, 1971/72 - 58 km, 1972/73 - 73 km, 1973/74 - 212 km. The material included 3900 dead sea birds (mostly oiled) pertaining to 28 species. Most of the dead birds belonged to the following species: ***Clangula hyemalis***, ***Melanitta nigra***, ***Melanitta fusca***, ***Larus argentatus***, ***Somateria mollissima***, ***Larus ridibundus***, and ***Cepphus grylle***. One hundred seventy-three examined birds had oiled stomachs. The highest mortality was recorded in the winter months. (mas)

Górski, W., B. Jakuczun, C. Nitecki and A. Petryna. 1977. Badania smiertelnosci ptaków wodnych z powodu zanieczyszczen ropopochodnych na polskim wybrzezu Baltyku w sezonie 1974/75. (The investigation on the oil pollution on the Baltic coast in 1974/75.) Przeglad Zoologiczny 21(1):20-23. (in Polish with English summary)

The investigations were carried out from November 1974 to August 1975 on the Polish Baltic coast (205 km). The material contained 667 dead water birds from 20 species. The most numerous species were: ***Clangula hyemalis*** (46.8%), ***Melanitta fusca*** (15.2%), ***Melanitta nigra*** (10.4%), ***Larus argentatus*** (5.6%), ***Podiceps cristatus*** (5.1%) and ***Larus ridibundus*** (5.1%). The mean number of dead birds for 1 km of the coast was 3.2. This number was lower than in the previous years. The highest number of dead birds was found in March and April (42.3%). Eighty-two percent of birds had oiled plumage. (mas)

Górski, W., B. Jakuczun, C. Nitecki and A. Petryna. 1979. Badania smiertelnosci ptaków wodnych z powodu zanieczyszczen olejowych na polskim wybrzezu Baltyku w sezonie 1975/76. (The investigation on the oil pollution caused mortality of waterfowl on the Polish Baltic coast 1975/76.) Notatki Ornitologiczne 20(1-4):35-44. (in Polish with English summary)

The investigations were carried out from September 1975 to August 1976 on the Polish Baltic Coast (217 km). The material contained 3194 dead water birds pertaining to 30 species. The most numerous were: ***Clangula hyemalis*** (56.7%), ***Melanitta fusca*** (14.2%), ***Melanitta nigra*** (9.1%), ***Fulica atra*** (6.6%), ***Larus ridibundus*** (1.9%), ***Larus argentatus*** (1.8%) and ***Podiceps cristatus*** (1.6%). Eighty-six percent of dead birds had oiled plumage. The mean number of dead birds per 1 km of the investigated coast was 14.7 (12.6 with oiled plumage). This number was higher than in previous years. The highest number of oiled birds was found in March and April (74%). (mas)

Górski, W., B. Jakuczun, C. Nitecki and A. Petryna. 1980. Smiertelnosc ptaków wodnych na polskim wybrzezu Baltyku w sezonach 1976/77 i 1977/78. (Mortality of waterfowl on the Polish Baltic coast in the seasons 1976/77 and 1977/78.) Notatki Ornitologiczne 21(1-4):23-32. (in Polish with English summary)

This paper continues the presentation of results of long-term investigations on waterfowl mortality caused by oil pollution on the Polish Baltic coast and gives the results from the seasons 1976/77 and 1977/78 in different sections. The quantity of dead birds per 1 km of section is given. The most frequent victims of oil pollution on the Polish Baltic coast are sea ducks, gulls, coots, Crested Grebes, Mute Swans and Black Guillemots. On all the sections, the most common victim is the Long-tailed Duck. The annual cycle of mortality shows that, as a rule, the peak of mortality comes in March and April, and lowest mortality, in May to August (gulls and divers mainly). (mas)

Gorsline, J. 1982. The effects of ingested petroleum on some hormonal regulatory mechanisms in seabirds. Dissertation Abstracts International B. Science and Engineering 43(7):2122.

It has been suggested that circulating compounds derived from ingested crude oil may interfere with adrenocortical function in contaminated birds. To investigate this possibility, the uptake and systemic distribution of compounds derived from ingested petroleum was first assessed by measurements of the hydrocarbon-metabolizing activity of hepatic mixed function oxidase (MFO) activity. The occurrence of dosedependent increases in the rate of microsomal naphthalene metabolism ***in vitro*** verified that petroleum hydrocarbons do indeed circulate systemically in birds given food contaminated with any one of several crude oils.

The effects of the circulating petroleum compounds on adrenocortical function in contaminated birds were assessed with measurements of: (1) the resting plasma corticosterone concentrations by radioimmune assay, (2) the turnover and distribution of [1,2-^{3}H] corticosterone by steady state kinetic analysis, and (3) the rate of release of corticosterone from slices of adrenocortical tissue superfused ***in vitro*** with and without ACTH in the medium. (maa)

Gorsline, J. and W.N. Holmes. 1981. Effects of petroleum on adrenocortical activity and on hepatic naphthalene-metabolizing activity in Mallard ducks. Archives of Environmental Contamination and Toxicology 10:765-777.

Unstressed Mallard ducks (***Anas platyrhynchos***), given uncontaminated food and maintained on a short photoperiod, show two daily maxima in plasma corticosterone concentration ([B]); one occurring early in the light phase and a second just before the onset of darkness. After one week of exposure to food containing 3% (v/w) South Louisiana crude oil, plasma [B] were significantly lowered throughout the day. Similar abrupt declines in plasma [B] also occurred during the first 10 days of exposure to food containing 1% and 0.5% crude oil. Although the plasma [B] in birds consuming food contaminated with 0.5% crude oil increased between 10 and 50 days of exposure, the concentration after 50 days was still lower than normal. During the same interval, normal plasma [B] were restored in birds consuming food containing 1% and 3% crude oil. Significant increases occurred in the naphthalene-metabolizing properties of hepatic microsomes prepared from birds acutely exposed to all levels of petroleum-contaminated food and elevated levels were sustained throughout the first 50 days of exposure. Birds given food containing 3% crude oil for more than 50 days, however, showed steady declines in hepatic naphthalene-metabolizing activity. After 500 days, the activity was similar to that found in contemporaneous controls. During the same interval, the plasma [B] increased until the levels were higher than normal after 500 days of exposure; at this time, an inverse relationship, similar to that seen during the first week of exposure to contaminated food, was once more established between plasma [B] and the concomitant hepatic naphthalene-metabolizing activity. (aa)

Gorsline, J. and W.N. Holmes. 1982a. Adrenocortical function and hepatic naphthalene metabolism in Mallard ducks (***Anas platyrhynchos***) consuming petroleum distillates. Environmental Research 28(1):139-146.

The reductions in plasma corticosterone concentration and the increases in hepatic naphthalene-metabolizing activity that occur when Mallard ducks are acutely exposed to petroleum-contaminated food are each caused by distinct molecular-size classes of compounds in the whole crude oil. The decrease in plasma corticosterone concentration only occurred in birds given food contaminated with proportionate volumes of distillation fractions with boiling point ranges of X to 205°C and 205 to 399°C. Significant increases in total hepatic naphthalene-metabolizing activity, however, were only induced when birds were given food containing distillation fractions with boiling point ranges of 205 to 399°C and 399 to 482°C. The residual material containing compounds with boiling points in excess of 482°C had no effect on either plasma corticosterone concentration or hepatic naphthalene metabolism. Although the combined effects of the two distillation fractions that affected plasma corticosterone were approximately equal to that of the whole crude oil, the combined effects of the fractions that induced increases in hepatic naphthalene metabolism were almost twice that of the crude oil. Also, the relative abundance of the four distillation fractions were not the same and differences between their toxic potencies were identified with respect to both physiological parameters. (aa)

Gorsline, J. and W.N. Holmes. 1982b. Ingestion of petroleum by breeding Mallard ducks: Some effects on neonatal progeny. Archives of Environmental Contamination and Toxicology 11:147-153.

Breeding female Mallard ducks consuming petroleum-contaminated food show significant induced increases in the napthalene-metabolizing properties of microsomes prepared from their livers. Food contaminated with South Louisiana crude oil was more potent than food contaminated with similar concentrations of Prudhoe Bay crude oil and in each instance food contaminated with 3% (v/w) induced greater increases than food contaminated at the 1% level. These increases in hepatic naphthalene-metabolizing activity may reflect their responses to circulating petroleum contaminants derived from ingested crude oil. When incubated, fertilized eggs laid by the females consuming South Louisiana crude oil yielded ducklings that upon emergence possessed high levels of naphthalene-metabolizing activity associated with hepatic microsomes. In contrast, ducklings derived from eggs laid by females consuming food contaminated with Prudhoe Bay crude oil showed no increases in total hepatic naphthalene-metabolizing activity and only those ducklings hatched from eggs laid by females consuming food contaminated with 3% crude oil showed significantly induced levels of specific naphthalene-metabolizing activity at hatching.

During the first week of postnatal life both the uncontaminated ducklings and the ducklings hatched from eggs laid by females consuming food contaminated with South Louisiana crude oil showed initial transient rises in specific and total hepatic naphthalene-metabolizing activity. In each instance, these rises were proportional to the level of contamination in the food consumed by the females. Thereafter, the specific activities of the naphthalene-metabolizing enzyme in all ducklings declined to the level found at hatching in uncontaminated ducklings. Similarly, the total hepatic naphthalene-metabolizing activities in ducklings derived from females consuming food contaminated with 3% crude oil also declined to the level at hatching in uncontaminated ducklings. In contrast, after one week, ducklings hatched from eggs laid by females consuming food contaminated with 1% crude oil showed total hepatic naphthalene-metabolizing activities that were more than twice those found at hatching. (aa)

Gorsline, J. and W.N. Holmes. 1982c. Suppression of adrenocortical activity in Mallard ducks exposed to petroleum-contaminated food. Archives of Environmental Contamination and Toxicology 11(4):497-502.

Specific and total hepatic naphthalene-metabolizing activities increased three- to five-fold during ten days of exposure to food containing 3% South Louisiana crude oil; relative liver weights and hepatic microsomal protein concentrations remained unchanged. A single iv dose of [1,2-^{3}H] corticosterone disappeared exponentially from plasma of both uncontaminated and contaminated birds. The biological half-life, apparent volume of distribution, and the metabolic clearance rate of the labelled corticosterone was the same in the two groups of birds. Adrenal weight remained unchanged following exposure to contaminated food. Since the resting plasma corticosterone concentration in the contaminated birds showed a 72% reduction, the corticosterone secretory rate declined commensurately. Inner zone tissue from contaminated bird adrenal glands, superfused ***in vitro*** with medium containing no ACTH, released significantly less corticosterone than control tissue from uncontaminated bird adrenals. Addition of ACTH to the medium stimulated a 20-fold increase in corticosterone release from the tissue slices. In contrast, tissue from contaminated birds was significantly less sensitive to corticotropic stimulation and the same dose of ACTH elicited only one-fifth of the response that occurred in the control tissue. These results indicate that the decline in plasma corticosterone concentration occurring in birds consuming petroleum-contaminated food reflects a decrease in adrenocortical secretory rate due primarily to a decrease in corticotropic sensitivity of adrenocortical cells in the inner zone of the adrenal gland. (aa)

Gorsline, J.** and W.N. Holmes. 1982d. The effects of South Louisiana crude oil on adrenocortical function. ***in C.G. Scanes and M.A. Ottinger (eds.). Round Table Conference II: Effects of Environmental Pollutants on Avian Endocrine Systems. Second International Symposium on Avian Endocrinology. Benalmadena, Spain. Texas Tech. Press. Lubbock, Texas.

Gorsline, J. and W.N. Holmes. 1982e. Variations with age in the adrenocortical responses of Mallard ducks (***Anas platyrhynchos***) consuming petroleum-contaminated food. Bulletin of Environmental Contamination and Toxicology 29:146-152.

On day 1 of a 10-day experiment, male Mallards in three different age classes were fed control diets or diets of mash containing 3 ml South Louisiana crude oil per 100 g dry food. Birds were fed daily at the beginning of the light phase (08.00 h). On the eleventh day, the birds were sacrificed. Plasma samples were collected and livers were removed and frozen. There were no significant differences between rates of food consumption in the various age groups and no significant changes in body weight in each age group on either diet. Significant increases in specific and total hepatic enzyme activity occurred in each age group on the petroleum-contaminated diet. Significant decreases in plasma corticosterone concentration occurred in each group of contaminated birds, but was greatest in young birds and least in the oldest birds. Age seems to have been an important factor determining the degree of hypoadrenocorticalism developed following exposure to contaminated food. (st)

Gorsline, J., W.N. Holmes and J. Cronshaw. 1981. The effects of ingested petroleum on the naphthalene-metabolizing properties of liver tissue in seawater-adapted Mallard ducks (***Anas platyrhynchos***). Environmental Research 24(2):377-390.

Hepatic mixed function oxidase activities were estimated in seawater-adapted Mallard ducks (***Anas platyrhynchos***) that had been consuming food contaminated with one of five different types of crude oil. After 50 days of exposure to contaminated food, enzyme activities of liver microsomal preparations were assessed in terms of their naphthalene-metabolizing properties ***in vitro***. Although dose-dependent increases in the total hepatic enzyme activities (nmole naphthalene metabolized per minute per unit mass body weight) were observed in birds consuming food contaminated with each type of crude oil, three patterns of response were apparent. Crude oils from South Louisiana and Kuwait stimulated large and significant increases in the specific activity of the enzyme system (nmole naphthalene metabolized per minute per unit mass microsomal protein), whereas little or no increase in either microsomal protein content or relative liver weight were observed. In contrast, two crude oils from Santa Barbara, Calif., induced only small increases in specific activity but significant increases occurred in hepatic microsomal protein concentration and relative liver weight. The crude oil from Prudhoe Bay, Ala., evoked intermediate patterns of response. The possible significance of these data is discussed in relation to the survival of seabirds consuming petroleum-contaminated food and drinking water. (aa)

Grandpierre, J.-L., F. Leboulenger and F. Leuge. 1977. Une expérience de sauvetage d'oiseaux mazoutes. Le Courrier de la Nature. 49:117-129.

The paper presents a brief discussion on the effects of oil pollution on birds. Details are given of a cleaning program used for birds oiled in incidents of illegal dumping, and in a spill that resulted from a collision involving the tanker ***Peter Maes*** on the Pays de Caux coast. The numbers and species of oiled birds recovered, and the methods used in capturing, transporting, cleaning, drying, and rehabilitating the birds, are outlined. (st)

Grant, D. 1977. Oily birds. Underwater Naturalist 10(2):18-19.

In late December 1976, the oil tanker ***Olympic Games*** ran aground in Lower Delaware Bay and spilled 130,000 gallons of crude oil at a time when the bay was heavily populated with wintering waterfowl. Diving ducks, primarily Ruddy Ducks, some scaup, and one goldeneye comprised most of the total of oiled birds. Canada Geese were next, followed by the other surface feeders - Mallards, Black Ducks, and a single Whistling Swan. Treatment followed recommended procedures of previous recovery efforts. (st)

Grau, C.R., T. Roudybush, J. Dobbs and J. Wathen. 1977. Altered egg yolk structure and reduced hatchability of eggs from birds fed single doses of petroleum oils. Science 195:779-781.

Yolk deposited by Japanese Quail was abnormal for 24 hours after the oral administration of a single capsule containing 200 milligrams of Bunker C oil. Both the structure and the staining properties of the yolk were affected. Fewer eggs were laid during the 4 days after dosing, compared to controls, and hatchability was drastically reduced. Hatchability returned to normal in 4 days. Three other reference oils also affected yolk structure. Canada Geese given 2 grams and chickens given 500 milligrams of Bunker C oil produced eggs with abnormal yolk rings. (aa)

Grau, C.R., T.A. Wootton, T.E. Roudybush, W.N. Holmes, J. Cronshaw and D.G. Ainley. 1978. Detection of eggs from oil-fed birds by ultraviolet fluorescence of yolk extracts. ***in*** J. Siva-Lindstedt (ed.). Energy/Environment '78: A Symposium on Energy Development Impacts: Proceedings. 297-300.

To study the effects of chronic oil pollution on breeding birds, Mallards (***Anas platyrhynchos***) were fed Prudhoe Bay, South Louisiana, California Platform A and California Platform Holly crude oils at 1% or 3% of the diet over several months. Following treatment, eggs were frozen, fixed in 4% formalin, and sliced into 3-mm sections. Sections containing 2 g of wet yolk were dried in a vacuum oven, then broken up and extracted with petroleum ether. The extract was applied to a silia-gel thin-layer glass plate developed with isopentane:isopropanol:chloroform (100:0.50:0.1) and visualized by UV light (254 nm). Eggs from oil-treated ducks showed a bright blue fluorescence close to the front. (st)

Greenwood, J.J.D. 1969. Oil pollution of the east coast of Britain, February and March 1969. Marine Pollution Bulletin 17:12-14.

Evidence is presented that the large number of dead seabirds cast up on the British east coast in February and March 1969 were due to one or two large local oil spills and to an oil discharge off the west Friesan Islands, respectively. The implication of the pollution is that discharges can kill birds and pollute shores not only in its vicinity but also in large areas up to hundreds of miles away.

Greenwood, J.J.D. 1970a. Oiled seabirds in East Scotland. Marine Pollution Bulletin 1(3):35-36.

During the period from January 6 to February 4, 1970 over 8,000 oiled birds were destroyed or found dead along the east coast of Scotland. The most common victims were eiders (***Somateria mollissima***), guillemots (***Uria aalge***), Razorbills (***Alca torda***) and Black Scoters (***Melanitta nigra***). Gulls and surface feeding ducks were only slightly affected. The high proportion of eiders (coastal species) and the low proportion of offshore species, such as the puffin (***Fratercula arctica***), in the totals suggests that the oiling occurred locally just offshore.

Greenwood, J.J.D. 1970b. The problem of oiled birds. Tay Estuary Oil Pollution Scheme. Conference of Local Authorities and Other Bodies. 15-16 April 1970. Dundee. 21-22.

The problem of oiled birds in terms of the direct effect of oil on birds, the rehabilitation of oiled birds, and monitoring the damage caused by oil, are reviewed.

Greenwood, J.J.D., R.J. Donally, C.J. Feare, N.J. Gordon and G. Waterston. 1971. A massive wreck of oiled birds: north-east Britain, winter 1970. Scottish Birds 6:235-250.

Counts of beached birds, dead or dying, in north-east England and east Scotland in the period 1st January to 15th February, 1970 totalled 12,856 birds. An estimated 50,000 birds altogether were affected taking into consideration the numbers which perished at sea and were not washed ashore. Of the 12,856 birds, an estimated 12,400 were killed by oil. This incident involved mainly guillemots (***Uria aalge***), Razorbills (***Alca torda***), Little Auks (***Plautus alle***), puffins (***Fratercula arctica***), eiders (***Somateria mollissima***) and scoters (***Melanitta*** spp.). The time distribution of the beaching is presented. The amount of heavy fuel oil involved was small and believed to be discharged from general cargo vessels.

Greenwood, J.J.D. and J.P.F. Keddie. 1968. Birds killed by oil in the Tay Estuary, March and April 1968. Scottish Birds 5(4):189-196.

An account is given of the methods used to count affected birds during the oil pollution of the Tay Estuary that occurred in February 1968. The total of birds found dead, destroyed or taken into care was 1,368, most of them being eiders (***Somateria mollissima***). The diving birds were affected to an extent out of proportion to their numbers. The total mortality of eiders was probably about 2,000 though it may have been up to four times as high. This represents approximately 7% of the British population and repetition of the incident could have serious effects on the size of that population. (as)

Greenwood, J.J.D. and B.M. Marsault. 1971. Rehabilitating oiled seabirds. International Zoological Yearbook 11:245-251.

It is recommended that cleaning of oiled birds be postponed until birds have regained strength. The most urgent treatment is feeding with proprietary invalid foods followed by initial cleaning with lard or chalk powder if heavily oiled, and leaving them to recuperate. Diet, including the various dietary supplements and medications which have been successfully used, is given. Various types of cleaning agents for removal of oil from feathers are discussed. It is suggested that records of treated birds be kept in order to assess the effectiveness of the treatment.

Gregory, K.G. 1971. Oiled birds in Holland. Marine Pollution Bulletin 2(2):23.

The pollution by heavy fuel oil of waterways of the Biesbosch was cited. Interest was expressed in the success in rehabilitation of birds cleaned by a new cleaning mixture highly effective in removing large amounts of oil. The cleaning mixture is used to remove part of the oil and any remaining on the feathers could be rinsed away as a stable emulsion in water. An important component of the mixture is a biologically "soft" non-ironic detergent.

Grenquist, P. 1956. Öljytuhoista Suomen Aluevesillä v. 1948-1955. (Oil damage in Finnish territorial waters in 1948-1955). Suomen Riista 10:105-116. (English translation available as Canadian Wildlife Service TR-FIN-10).

Dumping of waste oil into Finnish waters from 1948 to 1955 caused the deaths of tens of thousands of Long-tailed Ducks (***Clangula hyemalis***) and to a much lesser extent of other ducks. An oil dumping ban came into effect in Finland in 1948 and in Swedish waters in 1956.

Griner, L.A. and R. Herdman. 1970. Effects of oil pollution on waterfowl. A study of salvage methods. U.S. Department of Interior. Federal Water Pollution Control Administration. 35 pp.

A study was made of salvage methods for waterfowl subjected to oil pollution. Mallards (***Anas platyrhynchos***) were the primary test species used. Aspects of the pathology of some of the waterfowl species involved in the Santa Barbara oil slicks were also investigated. Although some refined petroleum products contain toxic compounds, the Santa Barbara crude used as a test oil in this study produced no apparent ill effects. Polycomplex A-11 was found to be a rapid and effective cleaning agent for the removal of oil from bird plumage. Oil on bird plumage alters feather structures by replacing the small air pockets between barbules of the feather, thereby decreasing buoyancy and insulation. Removal of oil from down feathers is more difficult than from contour feathers. Ducks and geese are more amenable to treatment and post-treatment care than are the more aquatic birds, such as grebes, loons, auks, and murres. Confinement times should be as brief as possible, as the incidence of mycotic and other infectious diseases increases under long periods of close confinement. (aa)

Guillon, J.C. 1967. Les effets tardifs de l'intoxication par le mazout chez les oiseaux. (The delayed effects of crude oil poisoning in birds). L'Homme et L'Oiseau (9):15-16. (English translation available as Canadian Wildlife Service TR-FR-37)

The cause of death in 96 oiled birds which occurred up to 5 days after their capture was investigated. The species involved were Razorbills (***Alca torda***), guillemots (***Uria aalge***), puffins (***Fratercula arctica***), Black-throated Loons (***Gavia arctica***) and Shags (***Phalacrocorax aristotelis***). These birds were in good condition when captured and had resisted death from exposure to cold. The glandular lesions, notably those of the adrenal glands, indicated that the oiled bird is in a state of shock. It has suffered numerous shocks during its struggle to escape from the oil slick and again from its rescuer: and during its transport, cleaning and captivity. Secondly, the oiled bird suffers from oil poisoning. Autopsies revealed that the digestive tract, mainly in the upper portions, contained large quantities of oil mixed with the remains of feathers which formed plugs. The volume of the kidney was considerably enlarged and the color pale, indicating severe nephritis, The liver was dark in color and very much congested. The gall bladder was distended. Congestion was also noted in the entire intestine and abdominal cavity. In the majority of birds, there were signs of serious damage to the pancreas and adrenal glands. In some birds, there were air sac irritation lesions but never any pulmonary lesions.

Hadley, A.H. 1930a. A seabird tragedy. Bird Lore 32(2):169-172.

Thousands of seabirds perished when oil from a grounded oil-burning vessel, the *Edward Lukinback*, was pumped overboard during rescue operations. The White-winged Scoter (*Melanitta deglandi*) outnumbered all other victims as these birds winter in great numbers on the waters about Long Island, New York, U.S.A..

Hadley, A.H. 1930b. Oil pollution and seabird fatalities. Bird Lore 32(3):241-243.

This is a further reference to seabird fatalities by oil discharged from the *Edward Lukinback* at various points along the coast of Massachusetts, U.S.A..

Hadley, A.H. 1931. Destruction of birds by oil pollution. Transactions of the North American Game Conference 17:64-69.

Further reference to seabird fatalities by oil discharged from the *Edward Lukinback* is made.

Haila, Y. 1970. M.T. Palvan Öljyonnettomuus. (The tanker *Palva* disaster involving oil pollution). Suomen Riista 22:7-13. (English translation available as Canadian Wildlife Service TR-FIN-6)

The cleaning operations in the area between Utö and Föglo Archipelago polluted with 150 tons of Russian crude oil are described. Bird loss in the Kökar archipelago predominantly involved the eider (*Somateria mollissima*) and it is estimated that over 1,000 eiders were killed with both sexes suffering equal losses. Oil pollution in the archipelago occurred during the eiders' nesting period. Eider duckling censuses showed significant differences in the number of ducklings between polluted and unpolluted areas. Numerous nests with unhatched eggs were abandoned and considerable numbers of eider chicks perished because of the oil pollution.

***Hald-Mortensen, P.** 1971. Oliefugle. (Oiled birds). Feltornithologen 13:186-190.

Hall, J.J. 1977. Oil pollution of the Cam. Report of the Cambridge Bird Club 50(1976):62-63.

During a heavy rainstorm on July 15, 1976, a large quantity of oil entered the River Cam through a rainwater outlet on the east bank, below Elizabeth Bridge. Birds oiled in the incident included Mallards, Moorhens, and Mute Swans. (st)

***Hansen, D.J.** 1983. The relative sensitivity of seabird populations in Alaska to oil pollution. United States Bureau of Land Management Technical Paper No. 3. 32 pp.

Hansen, E.B. 1978. *Olieforening Som Fare For Vore Havfugle.* (Oil pollution as a threat to our seabirds). Feltornithologen 20(2):72-75. (in Danish)

In an overview of oil pollution and seabirds, emphasis is given to the problem in and around Danish waters. (st)

Hansen, K. 1973. Et offer for det stadigt stigende national bruttonprodukt. (A victim of the continually rising gross national product). Feltornithologen 15(3):133. (in Danish)

An oiled Black Guillemot was found sitting on a beach at Hjelm. The oil had been dumped by a ship to save expensive time in port. The bird had to be destroyed.

Surveys indicated that over a four year period the number and size of oil catastrophes in Denmark rose steadily. After one illegal dumping in 1972, 15-20,000 diving ducks were oiled. It has to be determined if losses due to hunting and oil spills are responsible for the loss of nesting and wintering birds on the Danish coast. (st)

Harris, J.M.** 1980. Management of oil-soaked birds. ***in R.W. Kirk (ed.). Current Veterinary Therapy VII. W.B. Saunders. Philadelphia. 687-691.

Harrison, J.G. and W.F.A. Buck. 1967. Peril in perspective. An account of oil pollution in the Medway Estuary. Special supplement to the Kent Bird Report 16(1967). Kent Ornithological Society. 24 pp.

The immediate effect of oil pollution on bird life was a known casualty of 2778 birds involving 32 species, the majority of which were gulls. The Black-headed Gull (***Larus ridibundus***) and the Great Black-backed Gull (***Larus marinus***) were the most seriously affected. The oil was carried into their roosting areas on the night tides and caught the gulls while at rest in the tideway. A high mortality was also noted among the waders. While the gulls became contaminated en masse by floating oil, the waders were becoming contaminated by stranded oil when feeding at low tide. Short-legged waders such as the Dunlin (***Calidris alpina***) were relatively hardest hit. Post mortem studies on dead oiled birds attributed the death to hypothermia, resulting from a failure of the insulating properties of the plumage and aggravated by starvation. The prolonged effect on bird life was a decrease, in varying degrees, in the number of different species utilizing the estuary the following winter. This was correlated with food shortage resulting from the destruction of plant and animal life on the saltings and intertidal zones by oil and detergent. But almost all species studied recovered in numbers extremely well the second winter. The effect of the oiling disaster on the number of breeding birds of the estuary seemed minimal as only six species showed some decrease attributable to the accident.

Harrison, J. and W.F.A. Buck. 1968. The second winter survey following the Medway oil pollution of 1966. The Wildfowlers' Association of Great Britain and Ireland. Annual Report and Handbook 1967-1968:68-71.

A second survey of certain waterfowl and waders was carried out to determine any food shortages as reflected in the decrease in number of birds utilizing the regions previously polluted with oil and treated with detergents. Such species as the curlew (***Numenius arquata***), oystercatcher (***Haematopus ostralegus***), redshank (***Tringa totanus***), Brent Goose (***Branta bernicla***) and the shelduck (***Tadorna tadorna***), which significantly decreased in number after the pollution incident, showed statistically significant rises. These recovery results indicate that adequate food is available to support the winter populations.

Harrison, J. and P. Harrison. 1967. Oil pollution fiasco on the Medway Estuary. Birds 1:134-136.

An inshore oiling disaster occurred on the Medway Estuary in September 1966. Seventeen thousand tons of diesel crude leaked from the tanker ***Seestern***. The oil was carried into the estuary by a flooding tide backed by a north-east wind and polluted 8,000 acres of saltings. The number of bird corpses counted totalled 2,772 but the actual toll was estimated at 5,000 as many bodies were seen floating out to sea, others found inland and as bodies of smaller birds hidden in masses of oily seaweeds were difficult to find. Inasmuch as grebes and large numbers of wildfowl would soon arrive and as beaches were likely to be repeatedly polluted as the oil washed off the saltings, emulsifiers were used (mainly Gamlen) to clean the saltings. Both the oil and the emulsifiers were toxic to plant and animal life. Consequently, a great number of molluscs, crustacea and shellfish died, while sea lettuce and salting plants covered in oil were destroyed.

Hartung, R. 1963. Ingestion of oil by waterfowl. Papers of Michigan Academy of Science, Arts, and Letters 48:49-55.

The ingestion of oil by waterfowl was established in an experiment where small quantities of oil labelled with radioactive iodine were painted on the chest feathers of Black Ducks (***Anas rubripes***). The fate of the oil was followed by measuring the radiation from the birds' feathers, feces and cage during the course of the experiment. A certain amount of oil was rubbed off on the cage but far more was ingested as the radiation levels from the feces were consistently greater than that from the cage. By the end of 8 days about half the oil had been removed from the feathers, largely by preening. Thereafter, little more was removed. To determine the amount of oil which might be ingested by preening under natural conditions, oil was extracted from five moderately oiled Lesser Scaups (***Aythya affinis***) picked up dead after an oiling incident. The average amount of foreign oil on the ducks was 3.5 g so that these birds might have swallowed 2-3 g of oil in the process of preening. The feeding of Mallards (***Anas platyrhynchos***) with 2 g/kg body weight of cutting oil resulted in the reduction of mobility accompanied by diarrhea, loss of balance and coordination, and some tremors.

Hartung, R. 1965. Some effects of oiling on the reproduction of ducks. Journal of Wildlife Management 29(4):872-874.

After ingestion of 2 g/kg of a relatively non-toxic lubrication oil, one Mallard (***Anas platyrhynchos***) and two Pekins stopped laying for about 2 weeks. Very small quantities of oil coated on Mallard eggs reduced their hatchability to 21% compared to 80% found for unoiled Mallard eggs. Experimentally oiled Mallards continued incubating their clutches, but their eggs did not hatch even though they continued incubation for longer than normal periods. (aa)

Hartung, R. 1967. Energy metabolism in oil-covered ducks. Journal of Wildlife Management 31(4):798-804.

The metabolic rates of ducks covered with known quantities of oils were measured indirectly by determining total quantities of exhaled carbon dioxide. Metabolic rates increased linearly with decreasing ambient temperatures. Regression analyses of the metabolic rate-temperature plots made it possible to assess the heat conductivities of normal and oiled duck plumages. A dose-response curve could be established for the effects of oiling on the estimated heat conductivity. The lower lethal temperature for oiled and normal ducks could not be determined and was less than -26°C. Mortalities at those temperatures appear to be delayed until fat reserves are used up. The usual reduction in food intake by oiled ducks in conjunction with sharply increased metabolic rates can result in an "accelerated starvation". Recovery toward normal metabolic rates after oiling was observed. (aa)

Hartung, R. and G.S. Hunt. 1966. Toxicity of some oils to waterfowl. Journal of Wildlife Management 30(3):564-570.

A number of industrial oils were tested for their toxic effect on waterfowl. All oils were able to cause lipid pneumonia, gastrointestinal irritation, fatty livers, and adrenal cortical hyperplasia when fed to ducks in single doses by a stomach tube. Feeding of a cutting oil and a diesel oil also resulted in acinar atrophy of the pancreas. The diesel oil and a fuel oil produced toxic nephrosis in a number of animals. Feeding the cutting oil produced a definite inhibition of cholinesterase activity while the diesel oil depressed cholinesterase activity only slightly. Approximate LD_{50} values were determined for a number of oils under different environmental conditions. Gross examination of a series of 41 ducks which had been killed by oil pollution in the wild showed, at autopsy, changes similar to those encountered in the experimentally fed ducks. It was concluded that the toxicity of polluting oils is a definite factor in the observed mortalities due to oil pollution. (aa)

Harvey, S., H. Klandorf and J.G. Phillips. 1981. Reproductive performance and endocrine responses to ingested petroleum in domestic ducks (*Anas platyrhynchos*). General and Comparative Endocrinology 45:372-380.

The onset of lay by Khaki Campbell ducks transferred from a short-day (8L:16D) to a long-day photoperiod (16L:8D) was delayed by at least 4 weeks in birds fed 5 ml of North Sea crude oil per 100 g day wt of food, compared with birds fed an uncontaminated control diet. Over a 20-week period the oviposition rate and shell thickness of eggs laid by the birds fed 5% oil were greatly reduced. Refeeding the oil-fed birds with the uncontaminated diet increased oviposition rate and egg-shell thickness but not to the level in the controls. Throughout the experiment the plasma levels of prolactin and corticosterone in blood samples taken at weekly intervals were invariably less than those in the control birds. During photostimulation the mean plasma thyroxine concentration in the oil-fed birds was higher than the level in the controls but significant increases in the weekly concentration were only observed after the effects of petroleum on reproduction were manifest. The circulating concentrations of triiodothyronine were unaffected by oil ingestion. These results suggest that decreased ovarian activity in the oil-fed birds was not due to antigonadal effects of increased prolactin secretion or adrenocortical activity and an endocrine dysfunction of the thyroid is unlikely to be causally reponsible for the effects of petroleum on avian reproduction. (aa)

Harvey, S.**, J.G. Phillips and P.J. Sharp. 1982. Reproductive performance and endocrine responses to ingested North Sea oil. ***in C.G. Scanes and M.A. Ottinger (eds.). Round Table Conference II. Effects of Environmental Pollutants on Avian Endocrine Systems. Second International Symposium on Avian Endocrinology. Benalmadena, Spain. Texas Tech. Press. Lubbock, Texas.

Harvey, S., P.J. Sharp and J.G. Phillips. 1982. Influence of ingested petroleum on the reproductive performance and pituitary-gonadal axis of domestic ducks (***Anas platyrhynchos***). Comparative Biochemistry and Physiology 72C(1):83-89.

1. The chronic ingestion of a sublethal dose (5%) of dietary North Sea crude oil delayed the onset of lay in adult Khaki Campbell ducks transferred from a short (8L:16D) to long day (16L:8D) photoperiod and greatly reduced the rate of oviposition and quality (weight and shell thickness) of the eggs subsequently laid.
2. Refeeding the oil-fed birds with the uncontaminated control diet stimulated the rate of egg production and improved egg quality, but in both cases not to the level in the controls.
3. Food intake and the plasma calcium level in the petroleum-fed birds were reduced, but these effects are unlikely to be causally responsible for the adverse effects of petroleum on avian reproduction.
4. Gonadotrophic (luteinizing hormone, LH) hormone secretion in the oil-fed birds was not suppressed and the impairment of reproductive performance was not due to low plasma LH levels.
5. The reduced rate of lay in the oil-fed birds was accompanied by low gonadal steroid (progesterone) levels. The detrimental effects of oil on reproduction may be due to direct or indirect effects on the ovary or shell gland. (aa)

Hatling, J. 1982. Forebyggende og beredskapsmessige tiltak for å begrense skadevirkninger av olje på sjöfugl. (Oil and seabirds). Var Fuglefauna 5(2):130-133. (in Norwegian with English summary)

This article describes the various ways by which oil pollution can be prevented, eg. through improved navigational systems, waste oil reception centres, increased fines, improved technology on oil rigs, etc. It also describes how the Norwegian authorities are experimenting with an aerial monitoring programme of busy shipping lanes. The limited use of booms and skimmers and the discussions around the toxicity of chemical dispersants in the cleaning up of oil spills is also discussed. (as)

Hautekiet, M.R. 1955. Vÿf jaar stookolieslachtoffers. (The fuel oil victims of five years). Wielewaal 11:289-294.

A beached bird survey along 7 km of Belgian coast during September to April, 1949-1955 resulted in the recovery of 710 bird victims of storms and oil pollution. Guillemots (***Uria aalge***), Razorbills (***Alca torda***), Black Scoters (***Melanitta nigra***) and kittiwakes (***Rissa tridactyla***) constituted 21.5, 16.2, 13.4 and 12.0 per cent of the casualties respectively.

Hay, K.G. 1979. Fish, birds, marine mammals, and sea turtles. Journal of Environmental Pathology and Toxicology 3(1-2):119-136.

Methods for determining the effects of oil spills on birds and other wildlife are described and emphasis is placed on the necessity of comparing evaluations of pre- and post-spill conditions. Potential sources of error are described. (st)

***Heldt, R.** 1955. Handleiding ter voorkoming van de verontreiniging van de zee door olie. (Manual for the prevention of the pollution of the sea by oil). Koninklÿke Nederlandse Reedersvereeninging 1955 (2):1-22.

***Heldt, R.** 1960. Tote Vögel im Spulsaum der Nordseeküste von Schleswig, insbesondere Eiderstedt. (Dead birds on the driftline of the North Sea coast of Schleswig, particularly around Eiderstedt). Mitt. Faun. Arb-Gem. Schleswig-Holstein 13:37-43.

Henneberg, H.R. 1955. Ölpestbeobachtungen auf Wangeroog. (Observations on oil pollution on Wangeroog). Beiträge zur Naturkunde Niedersachsens 8:102-105. (English translation available as Canadian Wildlife Service TR-FIN-10)

During the winters of 1953-1955, 131 oiled birds were found on Wangeroog, of which 56 were Black Scoters (***Melanitta nigra***) and 30 were Common Murres (***Uria aalge***). Attempts to clean oiled scoters with various cleaning agents met with no success.

***Le Héron** 2:59-63. 1977. Recensement des oiseaux trouvés morts sur le littoral nord et Pas de Calais 2ième Quinzaine de Février.

Heubeck, M. 1980a. A report to the Shetland Oil Terminal Environmental Advisory Group on oil pollution and seabird mortality in Shetland, 28th February to 18th March, 1979. Shetland Oil Terminal Environmental Advisory Group. 9 pp.

A total of 1751 dead, oiled birds were found on the Shetland coast outside the Yell Sound area from 28 February to 18 March, 1979. Nineteen species were affected; 67.7% of oiled birds recovered were guillemots. Freshly spilled heavy fuel oil may have caused the losses. (st)

Heubeck, M. 1980b. A report to the Shetland Oil Terminal Environmental Advisory Group on the Beached Bird Survey scheme in Shetland, March 1979 to February 1980. Shetland Oil Terminal Environmental Advisory Group. 20 pp.

Results of beached bird surveys in Shetland from March 1979 to February 1980 are reported in terms of numbers of birds found, average numbers of corpses/km, and percentages of corpses oiled. Species affected are listed by month and by area. (st)

Heubeck, M. and M.G. Richardson. 1980. Bird mortality following the ***Esso Bernicia*** oil spill, Shetland, December 1978. Scottish Birds 111(4):97-108.

A spill of 1,174 tonnes of heavy fuel oil from the tanker ***Esso Bernicia*** at the Sullom Voe oil terminal (Shetland) on 31st December 1978 polluted an estimated 105 km of the shoreline of Sullom Voe and Yell Sound. The effect on birds was both local and severe, with a known 3,702 birds of 49 species killed. Particularly affected were six species: Great Northen Diver (146), Shag (683), eider (570), Long-tailed Duck (306), guillemot (336) and Tystie (633). These species made up over 85% of the mortality.

An estimated 95% of seabirds and waterfowl present in Sullom Voe at the time of the spill were killed and at least 75% in Yell Sound. The total estimated mortality is thought not to exceed double the number of corpses found. (as)

***Hiatt, B.C.** 1973. Alcids on Long Beach Island. Cassinia 54:28.

Hjernquist, B. 1982. Olja i fågelskyddsområden-bekämpning och sanering. (Oil and bird sanctuaries - control and cleaning up). Fauna Flora (Stockholm) 77(3):195-202. (in Swedish)

Clean-up operations following an oil spill must be carefully planned and executed so as not to increase the damage to the bird population. To illustrate how clean-up operations can disrupt seabird populations, aspects of seabird biology which make populations especially sensitive to clean-up (eg. behavior, nesting habitat, food supplies) are outlined. Some of the seabird groups discussed are gulls, Razorbills (***Alca torda***), and Common Eiders (***Somateria mollissima***). (st)

Hoffman, D.J. 1978. Embryotoxic effects of crude oil in Mallard ducks and chicks. Toxicology and Applied Pharmacology 46(1):183-190.

Recent studies in this laboratory have revealed that surface applications of microliter amounts of some crude and fuel oils that coat less than 10% of the egg surface reduce hatching considerably in different avian species. Applications of paraffin compounds that coat equal areas of the egg surface do not reduce hatching, suggesting that toxicity is due to causes other than asphyxia. In the present study, 1-10 μl of South Louisiana crude oil, an API reference oil, were applied to the surface of fertile Mallard (***Anas platyrhynchos***) and chicken (***Gallus gallus***) eggs. Early embryolethality was greater in Mallard embryos than in chick embryos, but later embryolethality that coincided with the time of rapid outgrowth of the chorioallantoic membrane was more prevalent in chick embryos. The overall incidence of embryolethality was similar in both species. Retardation of growth as reflected by embryonic body weight, crown-rump length, beak length, and general appearance was more pronounced in chick than Mallard embryos. Teratogenic defects were more frequent in chick embryos, and incomplete or abnormal ossification of the skull was the most common. External application of equivalent amounts of a mixture of paraffin compounds present in crude oil had virtually no embryotoxic effects in either species, suggesting that other components including aromatic hydrocarbons and organometallics may cause the embryotoxicity. (aa)

Hoffman, D.J. 1979a. Embryotoxic and teratogenic effects of crude oil on Mallard embryos on day 1 of development. Bulletin of Environmental Contamination and Toxicology 22:632-637.

At 24 h of development, Mallard (***Anas platyrhynchos***) eggs were subjected to external applications of South Louisiana crude oil in 1, 5 or 10 μl doses, or to 10 μl doses of a mixture of 9 aliphatic hydrocarbons. The aliphatic hydrocarbon mixture served as a control component of crude oil. All applications of crude oil on eggs resulted in a major decline in embryonic survival 3 days after treatment. A second major decline in survival occurred after day 7 and through day 10 of development. By day 18 of development, survival in the oil-treated groups ranged from 1.4 to 57%. Decreased growth as reflected by weight, crown-rump length, and bill length was significant in the 1 and 5 μl oil-treated groups. Applications of crude oil produced a number of abnormal survivors in the 1 and 5 μl treatment groups. Treatment with aliphatic hydrocarbons had virtually no effect on survival, embryonic growth, or number of defects. The toxicity of crude oil was not due to blockage of shell pores and subsequent hypoxia. (st)

Hoffman, D.J. 1979b. Embryotoxic and teratogenic effects of petroleum hydrocarbons in Mallards (*Anas platyrhynchos*). Journal of Toxicology and Environmental Health 5(5):835-844.

Egg surface applications of microliter quantities of crude and refined oils of high aromatic content are embryotoxic to Mallards (*Anas platyrhynchos*) and other avian species; applications of aliphatic hydrocarbons have virtually no effect.

Mallard eggs at 72 h of development were exposed to a mixture of aromatic hydrocarbons or to aromatic compounds representative of those present in crude oil to assess their toxicity. The class composition of the mixture was similar to that of South Louisiana crude oil, an American Petroleum Institute reference oil. Application of 20 μl of the mixture reduced embryonic survival by nearly 70%. The temporal pattern of embryonic death was similar to that after exposure to South Louisiana crude oil. Embryonic growth was stunted, as reflected by weight, crown-rump length, and bill length, and there was a significant increase in the incidence of abnormal survivors. When individual classes of aromatic hydrocarbons were tested, tetracyclics caused some embryonic death at the concentrations in the mixture. When classes were tested in all possible combinations of two, no combination appeared to be as toxic as the entire mixture. Addition of the tetracyclic compound chrysene to the aromatic mixture considerably enhanced embryotoxicity, but could not completely account for the toxicity of the crude oil. The presence of additional unidentified polycyclic aromatic hydrocarbons as well as methylated derivatives of polycyclic aromatic compounds such as chrysene may further account for the embryotoxicity of the crude oil. (aa)

Hoffman, D.J. 1979c. Embryotoxic effects of crude oil containing nickel and vanadium in Mallards. Bulletin of Environmental Contamination and Toxicology 23:203-206.

Treatment of Mallard eggs with crude oil or crude oil containing 700 ppm vanadium or nickel resulted in considerable and significant embryonic mortality compared with untreated controls. Although external applications of crude oil containing high concentrations of vanadium or nickel in the porphyrin form had about the same effect on embryonic survival as crude oil alone, embryonic growth was reduced and the percentage of abnormal survivors was significantly greater in the presence of either metal. Abnormalities included bill and eye defects, hydrocephaly, and stunted embryos with reduced feather formation. (st)

Hoffman, D.J. and P.H. Albers. 1984. Evaluation of potential embryotoxicity and teratogenicity of 42 herbicides, insecticides and petroleum contaminants to Mallard eggs. Archives of Environmental Contamination and Toxicology 13(1):15-27.

Results are reported for the embryotoxicity of 42 environmental contaminants applied externally to Mallard (*Anas platyrhynchos*) eggs including crude and refined petroleum and commercial formulations of herbicides and insecticides. Many of the petroleum pollutants were embryotoxic and moderately teratogenic and had LD_{50}s of 0.3 to 5 μl per egg (6-90 μg/g egg). The most toxic was a commercial oil used for r control of road dust followed by South Louisiana crude oil, Kuwait crude, No. 2 fuel oil, Bunker C fuel oil, and industrial and automotive waste oil. Prudhoe Bay crude, unused crankcase oil, aviation kerosene, and aliphatic hydrocarbon mixtures were less toxic (LD_{50}s of 18 to over 75 μl) and less teratogenic. (maa)

Hoffman, D.J., W.C. Eastin, Jr. and M.L. Gay. 1982. Embryotoxic and biochemical effects of waste crankcase oil on birds' eggs. Toxicology and Applied Pharmacology 63(2):230-241.

Waste crankcase oil (WCO) is a major source of oil pollution in both the aquatic and terrestrial environment and has been implicated in the poisoning of mammals and fish. It is also mutagenic. Since birds' eggs are highly sensitive to external microliter applications of environmentally polluting oils, we examined the developmental effects of external applications of WCO on eggs of the Mallard duck (*Anas platyrhynchos*) and the Bobwhite quail (*Colinus virginianus*). At 48 hr of development, Mallard eggs were exposed externally to 2, 5, or 15 μl of WCO or 15 μl of clean crankcase oil (CCO) while Bobwhite eggs received proportional doses of 0.5, 1 or 3 μl of WCO and 3 μl of CCO in a similar manner. WCO was highly embryotoxic to both species compared to CCO and resulted in dose-dependent mortality, reduced growth, and abnormal survivors. Application of 15 μl WCO resulted in 84% mortality in Mallards and 3 μl WCO resulted in 88% mortality in Bobwhites. Abnormal survivors included embryos with subcutaneous edema, incomplete ossification, and eye and brain defects. Red blood cell δ-aminolevulinic acid dehydratase (ALAD) activity, liver ALAD activity, and hemoglobin concentration were significantly lower after treatment with WCO in embryos and hatchlings of both species. Plasma uric acid, plasma alanine aminotransferase (ALT), and plasma aspartate aminotransferese (AST) were significantly elevated in WCO-treated Mallards after hatching. Biochemical effects, growth retardation, and mortality at proportionally lower dose levels were more pronounced in Mallards than in Bobwhites. Chemical analysis of the WCO and CCO revealed a considerably higher content of aromatic hydrocarbons in WCO than in CCO. Lead levels were highly elevated in WCO (4600 ppm) compared to CCO (2 ppm). (aa)

Hoffman, D.J. and M.L. Gay. 1981. Embryotoxic effects of benzo[a]pyrene, chrysene, and 7,12-dimethylbenz[a]anthracene in petroleum hydrocarbon mixtures in Mallard ducks. Journal of Toxicology and Environmental Health 7(5):775-787.

Studies with different avian species have revealed that surface applications of microliter amounts of some crude and fuel oils that coat less than 10% of the egg surface result in considerable reduction in hatching with teratogenicity and stunted growth. Other studies have shown that the embryotoxicity is dependent on the aromatic hydrocarbon content, further suggesting that the toxicity is due to causes other than asphyxia. In the present study the effects of three polycyclic aromatic hydrocarbons identified in petroleum were examined on Mallard (***Anas platyrhynchos***) embryo development. Addition of benzo[a]pyrene (BaP), chrysene, or 7,12-dimethylbenz[a]anthracene (DMBA) to a synthetic petroleum hydrocarbon mixture of known composition and relatively low embryotoxicity resulted in embryotoxicity that was enhanced or equal to that of crude oil when 10 μl was applied externally to eggs at 72 h of development. The order of ability to enhance embryotoxicity was DMBA>BaP>chrysene. The temporal pattern of embryonic death was similar to that reported after exposure to crude oil, with additional mortality occurring after outgrowth of the chorioallantois. Retarded growth, as reflected by embryonic body weight, crown-rump length, and bill length, was accompanied by teratogenicity. Abnormal embryos exhibited extreme stunting; eye, brain, and bill defects; and incomplete ossification. Gas chromatographic-mass spectral analysis of externally treated eggs showed the passage of aromatic hydrocarbons including chrysene through the shell and shell membranes to the developing embryos. These findings suggest that the presence of polycyclic aromatic hydrocarbons in petroleum, including BaP, chrysene, and DMBA, significantly enhances the overall embryotoxicity in avian species. (aa)

***Holmes, W.N.** 1981. Sub-lethal effects of ingested petroleum on laboratory maintained Mallard ducks: Evidence for the suppression of adrenocortical and ovarian function. Bird Workshop, St. George Synthesis Meeting. 28-30 April, 1981. Anchorage, Alaska.

Holmes, W.N.** 1985. Petroleum pollutants in the marine environment and some of their possible effects on hormonal regulation in marine birds. ***in B.K. Follett, I. Susumu and A. Chandola (eds.). The Endocrine System and the Environment: Meeting, October 1983. Springer-Verlag New York, Inc.: Secaucas, New Jersey, USA; Berlin, West Germany; Japan Scientific Societies Press: Tokyo, Japan. ISBN 0-387-15101 X; ISBN 3540-15101-X; ISBN 4-7622-8423-8. pp. 201-212.

Holmes, W.N., K.P. Cavanaugh and J. Cronshaw. 1978. The effects of ingested petroleum on oviposition and some aspects of reproduction in experimental colonies of Mallard ducks (*Anas platyrhynchos*). Journal of Reproduction and Fertility 54(2):335-347.

Compared to unmated Mallard ducks fed an uncontaminated diet, unmated birds given food contaminated with 3 ml South Louisiana crude oil per 100 g dry weight showed an 84% decline in the daily rate of oviposition, a 33% decrease in egg-shell thickness and at autopsy more than 82% of the ovarian mass consisted of atretic follicles. Similar studies on groups of mated females showed that although the addition of 1 ml South Louisiana crude oil/100 g dry food had no effect on the daily rate of oviposition, none of the eggs had been fertilized, while a concentration of 3 ml South Louisiana crude oil/100 g dry food suppressed the daily rate of oviposition significantly. Less than 25% of these eggs had been fertilized and only 40% of the fertilized eggs yielded viable ducklings. In both of these groups of mated birds, normal patterns of oviposition, fertilization and hatchability were restored after removal of petroleum from the diet.

The addition of 1 ml of Kuwait crude oil/100 g dry food had no effect on the rate of oviposition, the incidence of fertility or the hatchability of the fertilized eggs. The addition of 3 ml oil/100 g dry food completely abolished oviposition, but a normal rate of oviposition was restored when the concentration of the crude oil was reduced from 3 to 1 ml/100 g dry food. However, the incidence of fertilization remained low and none of the fertilized eggs gave rise to viable ducklings. Kuwait crude oil had no effect on shell thickness. (as)

Holmes, W.N.**, K.P. Cavanaugh and J. Gorsline. 1983. Environmental pollutants and the endocrine system: Some effects of ingested petroleum in birds. ***in D.K.O. Chan and B. Lofts (eds.). Proceedings of the IXth International Symposium on Comparative Endocrinology. 1981. Hong Kong. University of Hong Kong Press. Hong Kong.

Holmes, W.N. and J. Cronshaw. 1977. Biological effects of petroleum on marine birds. ***in*** D.C. Malins (ed.). Effects of Petroleum on Arctic and Subarctic Marine Environments. Academic Press. New York. 3 359-398.

The following topics are covered: total seabird mortality due to oil pollution, the vulnerability of different species to oiling, the effect of oil pollution on future seabird populations, differential mortalities of various species, and the physical, systemic, and pathological effects of oiling. (st)

Holmes, W.N., J. Cronshaw and K.P. Cavanaugh. 1978. The effects of ingested petroleum on laying in Mallard ducks (*Anas platyrhynchos*). *in* J. Siva-Lindstedt (ed.). Energy/Environment '78: A Symposium on Energy Development Impacts: Proceedings. 301-309.

To test the effects of ingested petroleum on egg-laying in Mallards, ducks were fed diets containing 1% or 3% South Louisiana crude oil (SLCO), or 1% or 3% Kuwait crude oil (KCO). Ducks fed 1% SLCO showed no change in mean daily rate of laying, but egg shell thickness was reduced by 19% and no eggs were fertilized. Diets of 3% SLCO resulted in an 80% decrease in laying rate, a 33% reduction in egg shell thickness, and a degeneration of greater than 80% of all eggs developing in the ovaries. Fertilization incidences were reduced by 25%. Hatchability declined from a norm of 88% to 40%. Ducks fed 1% KCO showed no change in rates of laying, egg shell thickness, fertilization or hatchability. Egg laying ceased in ducks fed 3% KCO, but all reproductive features returned to normal when the concentration of KCO was reduced to 1%. (st)

Holmes, W.N., J. Cronshaw and J. Gorsline. 1978. Some effects of ingested petroleum on seawater-adapted ducks (*Anas platyrhynchos*). Environmental Research 17 (2):177-190.

Male Pekin ducks adapted to seawater and maintained under sheltered conditions (27°C) in the laboratory may consume considerable volumes of petroleum without showing overt symptoms of distress. Under these conditions, birds consuming petroleum-contaminated food have shown a persistent hyperphagia; this was most apparent among those given food contaminated with South Louisiana crude oil, least apparent among birds given No. 2 fuel oil, and intermediate among those that consumed food contaminated with Kuwait crude oil. When maintained at 27°C, some mortality occurred among the birds given South Louisiana crude oil (22.2%) and No. 2 fuel oil (35.7%), whereas none of the freshwater- and seawater-maintained birds given uncontaminated food and none of the birds given Kuwait crude oil died during this period. Following their exposure to chronic mild cold stress (3°C), mortality occurred in all groups of birds; the birds that had consumed petroleum-contaminated food tended to die earlier and in larger numbers than either the seawater- or freshwater-maintained control birds. These effects suggest that the mortality in all groups of birds was due primarily to the additive effects of a series of nonspecific stressors. Thus, at autopsy, birds that had succumbed to the effects of these stressors frequently showed adrenal hypertrophy and severe involution of the lymphoepithelial tissues. The consumption of petroleum-contaminated food seemed to constitute only one of a series of environmental stressors, and, among birds that were already exposed to stressors such as hypertonic drinking water and persistent cold, the ingestion of petroleum seemed to render them more vulnerable and death frequently ensued. (aa)

Holmes, W.N., J. Gorsline and J. Cronshaw. 1979. Effects of mild cold stress on the survival of seawater-adapted Mallard ducks (*Anas platyrhynchos*) maintained on food contaminated with petroleum. Environmental Research 20(2):425-444.

1. Seawater-adapted Mallard ducks maintained in the laboratory will freely consume food that has been contaminated with either any one of a variety of crude oils or a petroleum derivative such as No.2 fuel oil.
2. During a 100-day experimental period total masses of petroleum equivalent to 50% of the mean body weight were consumed by some birds and many showed no apparent symptoms of distress.
3. The consumption of petroleum-contaminated food was frequently accompanied by a persistent hyperphagia but no clear patterns of change in body weight were associated with this condition.
4. Among those birds that survived the 100-day experimental period only small changes in mean body weight were observed between successive weighings and in most instances these represented less than 10% of the previously recorded weight.
5. In all groups, including those maintained on uncontaminated food, most of the mortality occurred following exposure to continuous mild cold stress. The total number of deaths in the groups given petroleum-contaminatd food, however, was always higher than that among birds given uncontaminated food.
6. The spate of mortality that occurred in groups given petroleum-contaminated food usually occurred earlier, lasted longer, and involved more birds than it did among groups fed uncontaminated food.
7. The pattern of each episode of mortality was sometimes quantitatively related to the concentration of petroleum in the food and a striking range of relative toxicities were observed among the crude oils from different geographic regions.
8. Throughout the experiment, the mean body weight of the birds that died was always significantly less than that of the survivors in the same group; in all instances most of the loss in weight occurred during the 2 weeks preceding death.
9. Autopsy revealed that adrenal hypertrophy and lymphoepithelial involution were characteristic in all of the birds that died, suggesting that a high level of adrenocortical stimulation preceded death. Such high levels of adrenocortical stimulation, therefore, probably occurred sooner in birds consuming petroleum-contaminated food than in birds given uncontaminated food.
10. The consumption of petroleum-contaminated food seemed to constitute a nonspecific stressor and among birds already exposed to stresses, such as hyperosmotic drinking water (seawater) and persistent cold, the ingestion of petroleum seemed to render them more vulnerable to adrenocortical exhaustion, and death frequently ensued. (aa)

Hope Jones, P. 1971. Ornithological beachcombing in Merioneth. Nature in Wales 12(4):203-206.

Nearly half of the total corpses found on two beaches in Merioneth, Wales, over a three year period were guillemots (***Uria aalge***) and Razorbills (***Alca torda***). Three species were badly affected by oil: 69% of the Razorbills, 61% of the Black Scoters (***Melanitta nigra***) and 54% of the guillemots. The beached birds were a mixture of Welsh breeding stock, of passage migrants and of winter visitors from outside the Irish sea.

Hope Jones, P. 1979. Roosting behaviour of Long-tailed Ducks in relation to possible oil pollution. Wildfowl 30:155-158.

Up to 2000 Long-tailed Ducks (***Clangula hyemalis***) winter in Scapa Flow, Orkney, feeding during the day in areas of shallow water; they probably comprise about 10% of the numbers wintering in Britain. Birds fly out before dusk to the deeper water of Scapa Flow, where they apparently roost in small parties scattered over a fairly wide area. North Sea oil arrives by pipeline at a terminal on an island in the Flow, and is onloaded by tankers at two moorings near the roosting areas; one oil slick has already crossed these roost areas during the daytime, and it is feared that a night-time spillage could have serious consequences for the ducks. (as)

Hope Jones, P., G. Howells, E.I.S. Rees and J. Wilson. 1970. Effect of ***Hamilton Trader*** oil on birds in the Irish Sea in May 1969. British Birds 63(3):97-110.

Of the 4,400 birds known to have been killed following damage to the tanker ***Hamilton Trader***, 91% were guillemots (***Uria aalge***) and 4% Razorbills (***Alca torda***). The actual casualties may have run as high as 10,000 but the inaccuracy of bird surveys and lack of knowledge as to the number which perished at sea makes this number a mere guess. An apparent 74% reduction in the local population of guillemots at the Ormes was observed after the peak kill. An experiment involving the dropping at sea of ringed dead auks showed that the auk corpses floating in open sea move at 2.2% of the wind velocity. Twenty percent of the experimentally ringed corpses were recovered within 4 months.

Hope Jones, P. and P.K. Kinnear. 1979. Moulting eiders in Orkney and Shetland. Wildfowl 30:109-113.

During the moult season (June to September) flightless Common Eiders (***Somateria mollissima***) are especially vulnerable to pollution from floating oil, so their distribution and estimated numbers were assessed for Shetland and parts of Orkney. In Shetland, the late summer population in 1977 was about 15,500 birds, with five flocks over 1,000 strong; Orkney, by contrast, may have supported only about 5,000 eiders at that time, most of them in small flocks which only rarely comprised as many as 400 individuals. The difference may be linked to food availability in sheltered sites, though this was not proved. (as)

Hope Jones, P., J.-Y. Monnat, C.J. Cadbury and T.J. Stowe. 1978. Birds oiled during the *Amoco Cadiz* incident - an interim report. Marine Pollution Bulletin (11):307-310.

Over 4500 oiled birds were collected from beaches in Northwest France and the Channel Islands following the oil spillage from the ***Amoco Cadiz*** in March 1978. Auks were the most abundant casualties: 1391 puffins (***Fratercula arctica***), 978 Razorbills (***Alca torda***) and 731 guillemots (***Uria aalge***), but there were also 126 divers (***Gavia*** spp.). A total of 33 bird species were recorded oiled. A corpse drift experiment suggested that after 30 March at least 3450 seabirds died off north Finestère alone; the total mortality in the first fortnight of the incident was probably considerably larger. (as)

Hope Jones, P., J.-Y. Monnat and M.P. Harris. 1982. Origins, age and sex of auks (Alcidae) killed in the ***Amoco Cadiz*** oiling incident in Brittany, March 1978. Seabird Report 6:122-130.

Hundreds of auks killed in the ***Amoco Cadiz*** oiling incident on the Brittany coast in March/April 1978 were examined. Seventy-eight per cent of 81 guillemots (***Uria aalge***) were still in winter plumage; males and females occurred in equal proportions. Among the remaining 22%, there were almost twice as many females as males. Of 95 guillemots examined, 13% were referable to the northern form of ***U.a.aalge*** and 59% to the southern form ***albionis***. The remaining 28% were intermediate. Of 225 Razorbills (***Alca torda***), 34% were immature, with males and females in almost equal proportions. There were almost twice as many females as males in the remaining 66%. All birds appeared to be ***A.t.islandica***. Of 213 puffins (***Fratercula arctica***) examined, 32% were immature, 15% intermediate, and 53% adults. Of 92 puffins sexed, 38% were males, 62% females. Most puffins appeared to come from the French and southern and western British populations of ***F.a.grabae***. (mas)

Horwood, H. 1959. Death has a rainbow hue. Canadian Audubon 21(3):69-73.

In a single disaster caused by oil waste dumped into the sea, over 12,000 oiled birds were washed ashore. Of these, over 3,000 were Common Eiders (***Somateria mollissima***). To protect seabirds from oil pollution which happens every spring and, at times, during other seasons, it was urged that Canada press delinquent nations to enter the international convention prohibiting oil dumping within 50 miles of a coastline. In addition, large zones on the high seas determined by ocean currents and winds should be set up in which oil dumping by all ships would be prohibited. Such zones would include the whole of the Gulf of St. Lawrence and the whole of the Banks of Newfoundland.

Houldson, F. 1952. Oil and the California Murre. Audubon 54:118-121.

As late as 1934, the California Murre (***Uria aalge***) was reported as being one of the least abundant species nesting on the Farallon Islands (off San Francisco, U.S.A.). The murre had been threatened to extinction by floating oil discharged by tankers before entering San Francisco Bay. As their numbers decreased, predation by gulls increased, adding pressure to the diminishing population. Through the efforts of wildlife societies, government agencies, and oil companies, shore tanks were installed to receive ballast water from tankers. The prevention of oil pollution has been so successful that murres now number in the thousands and hold their own against the gulls.

Hudson, R. 1967. Ringed victims of the ***Torrey Canyon***. British Trust Ornithological News 23:7-8.

This article reports on the recovery of 16 ringed seabirds oiled in the ***Torrey Canyon*** disaster. The ringed victims came from the Isles of Scilly, Pembrokeshire, Caernarvonshire, Co., Antrim and Outer Herbrides, i.e. chiefly from the Irish Sea and southwestern approaches.

Hunt, G.S. 1961. Waterfowl losses on the lower Detroit River due to oil pollution. Proceedings of the Fourth Conference on Great Lakes Research. University of Michigan, Ann Arbor. 10-26.

The causes of duck mortality on the lower Detroit River were investigated during the period 1948-1956. Oil pollution was found to be among the factors which caused the death of waterfowl in the area studied. Based on the field examination of 2,173 ducks in seven winters, the average loss of ducks due to oil was approximately 21%. Experiments were conducted to determine the effects of externally applied oils and of ingested oils.

Hunt, G.S. and A.B. Cowan. 1963. Causes of deaths of waterfowl on the lower Detroit River - winter 1960. Transactions of the North American Wildlife Conference 28:150-163.

An estimated 12,000 ducks perished from mid-March to early April 1960 on the lower Detroit River. Temperature data exclude the possibility of the inaccessibility of food supply resulting from ice coverage as a cause of death. Based on data from infra-red spectrophotometric analyses of oil extracted from the feathers and necropsies of 20 dead ducks, the authors concluded that the majority, if not all of the ducks studied, died as a result of oiling.

Hunt, G.S. and H.E. Ewing. 1953. Industrial pollution and Michigan waterfowl. Transactions of the North American Wildlife Conference 18:360-368.

The major factors involved in causing winter mortalities on the lower Detroit River are: contamination of ducks with pollutants such as oils, greases and, on one occasion, yellow phosphorus: starvation resulting from ice coverage of food sources: and exposure to cold weather. The first two factors may act independently, but in many cases the three factors are so interrelated as to be inseparable. Lead poisoning or disablement from gunshot wounds acounts for only a small portion of the winter losses.

Ibis 2(4):844-845. 1926. The oil menace.

The article gives a description of an exhibition portraying a beach dotted with birds destroyed by oil refuse from oil tankers, as found around the Isle of White and Dungeness, U.K.

Jehl, J.R., Jr., F.S. Todd. M.A.E. Rumboll and D. Schwartz. 1979. Pelagic birds in the South Atlantic Ocean and at South Georgia in the austral autumn. Le Gerfaut 69(1):13-27.

The importance of oiling to seabird populations around South Georgia was investigated during March - April 1977. Only 6 Gentoo Penguins were found oiled; four were heavily coated with fresh oil which apparently originated from a trawler that had been operating near shore. There was no indication that oiling had caused unusual mortality among seabird populations in the past, and current populations seemed largely unaffected. (st)

Jenssen, B.M., M. Ekker and C. Bech. 1985. Thermoregulation in a naturally oil-contaminated Black-billed Murre (***Uria aalge***). Bulletin of Environmental Contamination and Toxicology 35(1):9-14.

Data on body temperature, metabolic rate, and insulation in a Black-billed Murre contaminated during an oil spill at sea, are presented. A low metabolic rate recorded in this study contradicted earlier studies in which experimentally oiled ducks showed increased metabolicc rates. Three factors could explain this discrepancy. First, the body weight of the murre was well below the normal weight for this species. Starvation in other species has been shown to reduce metabolic rates. Second, the bird could have been suffering from the toxic effects of ingested oil. Third, experiments on eider ducks (***Somateria mollissima***) have shown that metabolic rates of oiled ducks are higher when the plumage is wet. The murre in this study had dry plumage when captured. The results indicate caution should be taken in extrapolating from laboratory data to field conditions. (st)

***Joensen, A.H.** 1970. Olieforurening og söfuglene. Dansk Vildtforskning 1969-1970:8-14.

***Joensen, A.H.** 1971. Olieforureninger i 1970. Dansk Vildtforskning 1970-1971:53-55.

Joensen, A.H. 1972a. Oil pollution and seabirds in Denmark 1935-1968. Danish Review of Game Biology 6(8):1-24.

The occurrence of oil pollution in Danish coastal waters during the period 1935-1968 is reviewed. The number of oil pollution incidents involving birds has increased but not as greatly as the increase in the amount of oil transported through Danish waters. The geographical distribution of all recorded oil pollution incidents shows that most of Danish waters are regularly affected. The greatest number of bird deaths occur in January and February. The species mainly killed by oil are: ***Somateria mollissima***, ***Melanitta nigra***, ***Melanitta fusca***, ***Clangula hyemalis***, ***Alca torda***, and ***Uria aalge***. During this period, the breeding populations of ***Somateria mollissima*** in Denmark and in the Baltic have been increasing while the populations of ***Clangula hyemalis*** in the Baltic have decreased. This reduction has been ascribed to mortality due to oil pollution.

Joensen, A.H. 1972b. Studies on oil pollution and seabirds in Denmark 1968-71. Danish Revue of Game Biology 6(9):1-32.

The occurrence of oil pollution involving birds in Danish waters from 1 July 1969 to 30 June 1971 is reviewed. Thirty incidents of oil pollution, each causing mortality of more than 100 birds, have affected at least 60,000 birds. In addition to these are thousands of oiled birds observed and destroyed by hunters. Fifty thousand birds of the estimated 60,000 were killed in the five disasters in the Kattegat involving relatively small amounts of oil. Ninety-five percent of the birds lost in these disasters were comprised of ***Somateria mollissima***, ***Melanitta nigra*** and ***Melanitta fusca***. It is evident from the geographical distribution of 30 oil pollution incidents and of oiled birds as reported by hunters in the questionnaire survey in the hunting seasons 1968-69 and 1969-70, that oil pollution occurs in almost all of Danish waters. Oil discharges in Danish waters are evenly distributed over most of the year but result in the greatest bird casualty between December and March.

Joensen, A.H. 1973a. Danish seabird disasters in 1972. Marine Pollution Bulletin 4(8):117-118.

In recent years the Danish Game Biology Station has studied casualties to seabirds from oil pollution. The annual number of seabirds killed by oil has been increasing continuously in recent decades, reaching a high-point in 1972. In addition to several minor cases of pollution causing the loss of hundreds of birds, two very serious disasters occurred in 1972, each of them killing more birds than ever before in one single oil incident. In March 1972, a minimum of 30,000 birds were oiled. The three main species affected were the eider duck (***Somateria mollisima***) (12,000-15,000), Common Scoter (***Melanitta nigra***) (10,000), and Velvet Scoter (***Melanitta fusca***) (7,000). The second disaster happened in December 1972 when a minimum of another 30,000 birds were oiled. Eiders comprised three-quarters of the total, and Common Scoters, the rest. (st)

Joensen, A.H. 1973b. Olieforureninger i 1972-73. (Cases of oil pollution 1972-1973). Dansk Vildtforskning 1972-1973:31-33. (English translation available as Canadian Wildlife Service TR-DAN-6)

The year 1972 was the worst year for oil pollution of seabirds in Danish waters. In March, approximately 15,000 to 20,000 birds were killed by oil in the Kattegat, and in December, about 20,000 eiders (***Somateria mollissima***) and 3,500 Black Scoters (***Melanitta nigra***) died on the tidal flats of the islands of Römö, Mandö and Fanö. Danish civil and military authorities have taken counter-measures to combat oil pollution by searching for oil at sea, stockpiling absorbents at several locations, and providing navy vessels with equipment for oil pollution control.

***Joensen, A.H.** 1978. Pollution of the Wadden Sea area. 4. Effects of pollution. 4. Oil pollution. 2. Bird mortality in the Wadden Sea caused by oil. 3. The Danish Wadden Sea. Report Wadden Sea Working Group. No. 8:59-60.

Joensen, A.H. and E.B. Hansen. 1977. Oil pollution and seabirds in Denmark 1971-1976. Danish Review of Game Biology 10(5):3-31.

Trends in seabird mortality from 1968-76, and seasonal and geographic distributions of seabird deaths in Denmark are discussed. Reports of two oil pollution disasters in 1972 are presented. Species affected by oil pollution are discussed. Other subjects covered include beached bird surveys, questionnaire surveys to duck hunters, and the collection of information on oiling incidents. (st)

***Joiris, G.** 1972. The behavior of oil-covered birds at sea. Aves 9(3):136-137.

Jones, B. 1983. Handling small numbers of oiled birds. American Association of Zoo, Parks and Aquariums Annual Conference Proceedings 503-510.

Methods for cleaning, feeding, housing, and rehabilitating oiled birds are outlined. Problems encountered with treating oiled loons and an oiled gannet are mentioned. (st)

Jouanin, C.** 1967. Chronique noire: Le naufrage du ***Torrey Canyon. Le Courrier de la Nature. 1-2:18-19.

Journal of Science 75(12):524. 1979. Rehabilitated penguins return to St. Croix, South Africa.

On 7 July 1979 at least 400 Jackass Penguins (***Spheniscus demersus***) oiled in an oil slick of unknown origin were sighted off St. Croix Island, near Port Elizabeth. One hundred, fifty penguins were captured and sent for cleaning to the South African National Foundation for the Conservation of Coastal Birds (SANCCOB). Ninety birds were banded to assess the effectiveness of treatment methods used by SANCCOB. Light oils were removed from the plumage by dusting with Fuller's earth and rinsing with cold, fresh water. Heavier oils were removed with an industrial light-duty detergent. Of 80 birds cleaned and released to date, 41 had returned to the island. Several rehabilitated penguins had started to moult their oil-damaged feathers. (st)

*****Journal of the Saudi Arabia Natural History Society** 1(8):16. 1973. Tacky terns.

Kay, R.S. 1967. Oil pollution of birds in southwest England. Journal of Small Animal Practice 8(4):189-192.

Little was known about rehabilitation of seabirds when the ***Torrey Canyon*** wreck took place. Cleaning centers were hurriedly set up to handle the large influx of oiled birds. Within a very short time, the best methods of treatment of oiled birds had to be assessed and the recommendations from this study are presented.

Kazama, T. 1968. On the mass destruction of ***Rissa tridactyla*** and ***Calonectris leucomelas*** and their migration at Kashiwazaki, Niigata Prefecture. Tori 18:260-266. (In Japanese with English summary).

The Kashiwazaki coast in Niigata, Japan is known as a place where seabirds are washed ashore and land bird migrants are disturbed. In the spring, kittiwakes (***Rissa tridactyla***) and shearwaters (***Calonectris leucomelas***) are observed migrating offshore. During this season, dead kittiwakes and shearwaters are beached after stormy weather and are found to have empty stomachs and their feathers often soiled by oil.

Kazama, T.** 1971. Mass destruction of ***Synthliborampus antiquus by oil pollution. Miscellaneous Reports of the Yamashina's Institute for Ornithology 6:389-398. (In Japanese with English summary).

Kerley, G.I.H., T. Erasmus and R.P. Mason. 1985. Effect of moult on crude oil load in a Jackass Penguin (***Spheniscus demersus***). Marine Pollution Bulletin 16(12):474-476.

Induced moult has been suggested as a technique for rehabilitating oiled seabirds. An oiled Jackass Penguin underwent natural moult in captivity. Analyses of oil extracted from premoult and postmoult feathers indicate little qualitative difference, with significant amounts of oil transferred from premoult to postmoult feathers. Inducing moult, therefore, does not appear to be viable for cleaning oiled seabirds. (as)

King, C.L. 1953. Oil sumps - duck nemesis. Wyoming Wildlife 17(11):32-33.

A survey in the Big Horn Basin drainage in Wyoming, U.S.A. indicates heavy mortality among surface-feeding ducks - Mallard (***Anas platyrhynchos***), Blue-winged Teal (***Anas discors***), Shoveler (***Spatula clypeata***) and Pintail (***Anas acuta***). A total of 914 birds were found floating in sumps over a two year period. The preventive measures tried are chemical treatment of effluents to eliminate floating oil film and scaring devices such as tin cans hungs from a wire.

King, J.G. and G.A. Sanger. 1979. Oil vulnerability index for marine oriented birds. *in* J.C. Bartonek and D.N. Nettleship (eds.). Conservation of Marine Birds of Northern North America. United States Fish and Wildlife Service. Washington, D.C. 227-240.

The 176 species of birds using marine habitats of the Northeast Pacific are graded on the basis of 20 factors that affect their survival. A score of 0, 1, 3, or 5, respectively, representing no, low, medium, or high significance is assigned for each factor. The total score is the Oil Vulnerability Index (OVI). The OVI's range from 1 to 100, an index of 100 indicating the greatest vulnerability. Using this system, one can rank the avifauna of different areas according to their vulnerability to environmental hazards as an aid in making management decisions. (aa)

King, K.A. and C.A. Lefever. 1979. Effects of oil transferred from incubating gulls to their eggs. Marine Pollution Bulletin 10(11):319-321.

No. 2 fuel oil, or water, was applied to the breast feathers of incubating Laughing Gulls trapped at their nest site on an island colony in Texas. Gulls were released after treatment and allowed to incubate their eggs for 5 days. Oil was transferred from the feathers of incubating adults to their eggs and resulted in 41% embryo mortality compared with 2% in controls. (as)

King, K.A., S. Macko, P.L. Parker and E. Payne. 1979. Resuspension of oil: Probable cause of Brown Pelican fatality. Bulletin of Environmental Contamination and Toxicology 23:800-805.

Of 46 oil spills reported in the Corpus Christi-Redfish Bay vicinity between 1 October and 26 November 1976, two spills were in areas frequented by Brown Pelicans (***Pelecanus occidentalis***). On 7 October, 10 barrels of oil spilled: on 13 October a pipeline ruptured, spilling 377 barrels of oil. Clean-up operations started 13 October and were completed on 14 October with 80-85% of the oil recovered. On 26 November, an adult Brown Pelican was found with 90-95% of its feathers lightly coated with oil. The bird died the following night, thus indicating that not all mortality associated with oil spills is immediate and obvious. This is the first instance of which the authors are aware that resuspended oil may have resulted in bird mortality. (st)

Kocwa, E. and J. Szewczyk. 1969. Mewy, ich biologia i rola higienicznosanitarna. (Sea gulls, their biology and role in health and hygiene). Wszechswiat 3:72-74. (English translation available as Canadian Wildlife Service TR-POL-4)

Gulls are useful scavengers, especially in harbours. Inasmuch as oil pollutes harbours, the gulls are threatened by this pollution.

König, D. 1966. Die Situation der Binnengewässer-Verschmutzung und der Gegenmasznahmen in der Bundesrepublik Deutschland im Hinblick auf die Vogelwelt. (The situation of inland water pollution and countermeasures taken by the Federal Republic of Germany with regards to birds). Internationaler Rat für Vogelschutz. Deutsche Sektion. Bericht Nr. 6:25-35.

General remarks are made on the relations between birds and pollution of waters; the necessity of further work on these problems is emphasized. The situation of the pollution of inland waters in the Federal Republic of Germany is demonstrated by some examples. The acts of defense against pollution are indicated by reference to the development of works for sewage purification, to research, to techniques, to administration and to literature. Finally some examples of unexamined ornithological questions are given as a suggestion for further investigations. (as)

Küchler, W. 1956. Kampf der Ölpest. (Fighting oil pollution). Falke 1956:198-200.

There are mainly three causes of oil spills: ship accidents, discharge of oil to calm the waves in case of an accident, and discharge of bilge water. Northern diving ducks and alcids are most vulnerable to spills. Ornithological organizations should seriously look into the problem of oil pollution of birds at sea. German field ornithologists and naturalists are requested to provide data on oiled birds to the ornithological station "Hiddensee".

Kuhleman, P. 1953. Die Entenkatastrophe von Hohwacht. (Duck catastrophe at Hohwacht). Ornithologische Mitteilungen 5(6):111-113. (English translation available as Canadian Wildlife Service TR-GER-90)

It is estimated that about 10,000 ducks became victims of oil dumping in the Hohwacht region, Germany, in January, 1953. Beach counts revealed that 90% of the affected ducks were Long-tailed Ducks (***Clangula hyemalis***) and Black Scoters (***Melanitta nigra***).

Kuschert, H. 1981. Dokumentation zum Seevogelsterben durch Ölpest zwischen November 1980 und Marz 1981. (Documentation of seabird mortality as a result of an oil spillage between November 1980 and March 1981). Corax 8(4): 310-313. (in German)

The catastrophic oil spill in the Skagerak was well covered by the news media. South-west winds caused the oil to drift to the Schleswig-Holsteins coast, where many birds became victims. That coast had never seen so many oiled seabirds. Of 4844 birds recovered, 34% were eider ducks, 21% were kittiwakes, and 19% were Common Murres. (st)

Kuyken, E. 1967. Steeds weer opniew: die stookoliepest. (Always, again and again; the fuel oil plague). Hamster 7:101-108. (English translation available as Canadian Wildlife Service TR-BEL-1)

The beached bird survey in February 1967 from Cape Griz-Nez to Braakman in the Wester Schelde covered 170 km of coast. 590 dead birds were found, 431 of which were oiled. The number of oiled birds located per kilometer increased from Griz-Nez to Zeebrugge and decreased towards the Wester Schelde. Of the oil victims, the most common were guillemots (***Uria aalge***), Razorbills (***Alca torda***), Black Scoters (***Melanitta nigra***), and Herring Gulls (***Larus argentatus***). Of the total beached birds found, these were the various proportions: Laridae 48.9%, Alcidae 30.3%, Anatidae 11.5%, true seabirds 4.2%, and Gaviidae and Podicipedidae 2.5%.

Kuyken, E. 1978. Beached bird surveys in Belgium. Ibis 120(1):122-123.

Beached bird counts along the Belgian coast were started in 1962. Total numbers of beached birds and percentages of oiled birds from 1962-77 are given. On average, about 70% of beached birds are oil victims. Numbers of oiled birds dropped after 1970, probably reflecting a decrease of chronic oil pollution in the coastal area. (st)

Kuyken, E. and P.M. Zegers. 1968. De stookolieslachtoffertelling van Februari 1968 langs de Nederlandse Kust. (The count of oiled birds along the Dutch coast in February 1968). Amoeba 44(5):153-158. (English translation available as Canadian Wildlife Service TR-DU-5)

Of the 1,660 dead birds found on 342 km of Dutch coastline, 1,400 birds were oiled. The average number of oil victims per kilometer of coast increased from 1.3 in 1966 and 1967 to 4.1 in 1968. In comparison, the average in February 1968 was 3.8 in France, 6.6 in Belgium, and 2.0 in Germany. The dominant oil victims on the Dutch coast were Black Scoters (***Melanitta nigra***), eiders (***Somateria mollissima***), guillemots (***Uria aalge***), Razorbills (***Alca torda***) and Herring Gulls (***Larus argentatus***).

LaFave, L.D. 1957. More seabirds affected by oil. Murrelet 38(1):8.

Additional numbers of dead oiled birds, mostly White-winged Scoters (*Melanitta deglandi*), were observed as a result of the oil released from the wrecked freighter *Seagate*.

***Lagache, J.P.** 1982. Relève des oiseaux morts trouvés sur les plages Nord et Pas de Calais en février 1982. Le Héron 1982(2):60-64.

***Lagache, J.P.** 1983. Oiseaux mazoutes sur la côte Nord et Pas de Calais janvier - février 1983. Le Héron 1983(2):77-83.

Lambert, G., D.B. Peakall, B.J.R. Philogène and F.R. Engelhardt. 1982. Effects of oil and oil dispersant mixtures on the basal metabolic rate of ducks. Bulletin of Environmental Contamination and Toxicology 29:520-524.

Adult Mallards (*Anas platyrhynchos*) were exposed to seawater to establish the basal metabolic rate (BMR) of each bird. Birds were then exposed to either Prudhoe Bay crude oil (PBCO), Corexit 9527, or PBCO + Corexit 9527, followed by further exposure to seawater. BMR was again determined by measuring exchange of respiratory gases. Exposure to oil caused a significant increase in BMR. Birds swimming in seawater and Corexit 9527 showed loss of buoyancy but no significant increase in BMR. Exposure to oil plus dispersant resulted in a significant increase in BMR but the increase was not significantly different from exposure to oil alone. The main effect of the dispersant, then, appears to be the damage done to plumage which results in progressive waterlogging. (st)

***Langenberg, J.A.** and F.J. Dein. 1983. Pathology of Ruddy Ducks contaminated with No. 6 fuel oil. *in* S.A. Barnes and D.G. Rosie (eds.). The Effect of Oil on Birds: Physiological Research, Clinical Applications, and Rehabilitation. Wilmington, Delaware. Tri-State Bird Rescue and Research.

Larsson, K. and G. Odham. 1970. Larodan for cleaning oiled seabirds. Marine Pollution Bulletin 1(8):122-124.

The loss of water-repellency in plumage of oiled birds washed with detergent is attributed mainly to the removal of the natural wax during washing. Larodan 127, formulated to overcome this problem, coats the feathers with a film of wax during cleaning. The preparation consists of monoglyceride, wax, and water. Larodan 127 has been tested on 10 Pekin Ducks contaminated with Shell talpa oil 30, to which carbon powder had been added. Only one washing was required to remove the oil after 3 days, and in 8-10 days, the birds could swim. In Gavle, Sweden, 75 birds belonging to the family Anatidae were successfully cleaned and returned to their natural environment within a fortnight.

Lauer, D.M.** et al. 1982. Rehabilitation of Ruddy Ducks (Oxyura j. jamaicensis***) contaminated with oil. JAVMA 181:1398-1399.

Lawler, G.C., J.P. Holmes, D.M. Adamkiewicz, M.I. Shields, J.-Y. Monnat and J.L. Laseter. 1981. Characterization of petroleum hydrocarbons in tissues of birds killed in the ***Amoco Cadiz*** oil spill. ***in Amoco Cadiz:*** Fates and Effects of the Oil Spill. Proceedings of the International Symposium. 19-22 November, 1979. Centre Océanologique de Bretagne. Brest (France). 573-583.

Combined high-resolution gas chromatography and mass spectrometry (GC/MS) was used to qualitatively and quantitatively analyze petroleum hydrocarbons in breast muscle and liver tissue of birds killed in the ***Amoco Cadiz*** oil spill. Gas chromatograms of saturated hydrocarbon fractions in Shag (***Phalacrocorax aristotelis***) breast muscle and in mousse from the spill were almost identical. Fractions from both the mousse and the breast muscle had an n-alkane series showing a somewhat Gaussian distribution, an isoprenoid alkane homologous series, and an alkylated cyclohexane homologous series. The latter two homologous series were also found in saturated fractions of tissues from Herring Gulls (***Larus argentatus***), Razorbills (***Alca torda***), and guillemots (***Uria aalge***). (st)

Lawler, G.C., W.-A. Loong and J.L. Laseter. 1978a. Accumulation of aromatic hydrocarbons in tissues of petroleum-exposed Mallard ducks (***Anas platyrhynchos***). Environmental Science and Technology 12(1):51-54.

Mallard drakes were dosed with 5 ml a day of South Louisiana crude oil for 14 days. Tissues from control and oil-dosed ducks were examined for aromatic petroleum hydrocarbons by combined high-resolution gas chromatography and mass spectrometry. Petroleum aromatics were found in every experimental tissue analyzed. The skin and underlying adipose tissue had far more accumulated aromatic hydrocarbons than the other tissues, which included: liver, breast muscle, heart muscle, brain, uropygial gland, and blood. Aromatic hydrocarbons did not accumulate in the same relative concentrations as found in the crude oil. The more toxic 2 or 3 condensed ring aromatics were accumulated to a greater extent than the alkylbenzenes. Squalene was detected in the feed and in every tissue examined, including the blood. Biphenyl was also present in the feed and accumulated in every control and experimental tissue but the blood. (aa)

Lawler, G.C., W.-A. Loong and J.L. Laseter. 1978b. Accumulation of saturated hydrocarbons in tissues of petroleum-exposed Mallard ducks (***Anas platyrhychos***). Environmental Science and Technology 12(1):47-51.

Mallard drakes were dosed with 5 ml a day of South Louisiana crude oil for 14 days. Tissues from control and experimental ducks were then examined for petroleum hydrocarbons by combined high-resolution gas chromatography and mass spectrometry. Three characteristics of the saturated hydrocarbon fraction were used to assess the presence of crude oil: the n-alkane distribution pattern, the presence of homologous series of petroleum-derived hydrocarbons, and the nC_{17}/pristane ratio. Oil was found in every experimental tissue examined but the brain. The skin (and underlying adipose tissue) contained the highest level of saturated petroleum hydrocarbons. The other tissues were ranked relative to the skin as follows: skin›uropygial gland›breast muscle, heart muscle›liver›brain. The blood contained low levels of petroleum-derived hydrocarbons 3-4 h after the final dose of crude oil. That saturated petroleum hydrocarbons did not accumulate in the duck tissues in the same relative amounts observed in South Louisiana crude oil suggested selective uptake and/or metabolism. (aa)

***Lea, D.** 1979. The Orkney beached bird survey. Bulletin of the Orkney Field Club. No. 3:8-9.

***Lebeurrier, E.** 1968. Rapport sur l'activité du centre d'accueil d'oiseaux mazoutes de Primel-Plougasnou. (Reports on the activity of the reception center for oil contaminated birds of Primel-Plougasnou). Penn ar Bed 6(52):220-224.

Lee, F.B. 1952. Waterfowl mortality due to oil pollution in the vicinity of Red Wing, Minnesota. Flicker 24(3):116-118.

As estimated 500 waterfowl were lost to oil pollution on the Mississippi River. The oily pollutant smelled like linseed oil. Goldeneyes and scaups were most adversely affected, and were the most numerous ducks in the river at the time.

Leighton, F.A. 1984. The toxicity of ingested crude petroleum oil to marine birds: Pathology and pathogenesis. Dissertation Abstracts International B. Sciences and Engineering 45(5):1434.

Experiments were carried out to identify toxic effects of ingested Prudhoe Bay crude oil in nestling Herring Gulls (***Larus argentatus***) and Atlantic Puffins (***Fratercula arctica***).

Hemolytic anemia with Heinz bodies in red blood cells occurred in gulls and puffins that ingested ≥ 10 ml oil per kg per day for 4-5 days. Biochemical lesions in affected red cells included membrane lipid peroxidation, methemoglobin formation, an increase in red cell reduced glutathione (GSH), increased plasma membrane permeability to NADH, and a reduction in oxygen-carrying capacity of hemoglobin in excess of that referable to methemoglobin. Structural lesions in red cells included Heinz body formation, anisocytosis, severe distortions of cell shape, plasma membrane crenulation, mineralization of mitochondria, formation of abnormal cytoplasmic vesicles, and both abnormally high and abnormally low cytoplasmic density. Histological lesions in liver, spleen, kidney, and bone marrow were consistent with intravascular and extravascular hemolysis and a regenerative response. Other lesions suggested immunosuppression in oil-dosed birds.

Oral doses of disulfiram prevented the usual induction of hepatic mixed-function oxidases caused by ingestion of oil by gulls, and also prevented development of Heinz bodies and of increased GSH in red cells of gulls given large oral doses of oil. (maa)

Leighton, F.A.**, R.A. Butler and D.B. Peakall. 1985. Oil and arctic marine birds, and assessment of risk. ***in F.R. Engelhardt (ed.). Petroleum Effects on the Arctic Environment. Applied Science Ltd. United Kingdom. 183-215.

Leighton, F.A., Y.Z. Lee, A.D. Rahimtula, P.J. O'Brien and D.B. Peakall. 1985. Biochemical and functional disturbances in red blood cells of Herring Gulls ingesting Prudhoe Bay crude oil. Toxicology and Applied Pharmacology 81(1):25-31.

Heinz body hemolytic anemia developed in Herring Gull (***Larus argentatus***) nestlings given oral doses of 10 ml of Prudhoe Bay crude oil per kilogram of body weight per day for 5 days. Associated disturbances in red blood cells were increased amounts of reduced glutathione (GSH), peroxidation of membrane lipids, an increase in membrane permeability, and a decrease in the oxygen-carrying capacity of cyanomethemoglobin-convertible hemoglobin. Among groups of gulls given different cumulative doses of oil over a 6-day period, significant covariance with dose and dependence on dose was demonstrated for packed cell volume, hemoglobin, and red cell GSH. Rapid defecation of oil by gulls indicated that the effective dose was substantially less than the administered dose. Pronounced damage to red cells occurred in some birds administered oil for only 2 days. These data imply that the toxic effects of ingested oil may contribute significantly to the morbidity and mortality of oil-contaminated birds. (aa)

Leighton, F.A., D.B. Peakall and R.G. Butler. 1983. Heinz-body hemolytic anemia from the ingestion of crude oil: A primary toxic effect in marine birds. Science 220:871-873.

Hemolytic anemia developed in young Herring Gulls and Atlantic Puffins given daily oral doses of a Prudhoe Bay crude oil. Anemia developed 4 to 5 days after the initiation of oil ingestion and was accompanied by Heinz-body formation and a strong regenerative response. The data evince a toxic effect on circulating red blood cells involving an oxidative biochemical mechanism and the first clear evidence of a primary mechanism of toxicity from the ingestion of crude oil by birds. (aa)

Leighton, F.P.** 1983. The pathology of petroleum oil toxicity in birds: A review. ***in S.H. Barnes and D.G. Rosie (eds.). The Effects of Oil on Birds: Physiological Research, Clinical Applications, and Rehabilitation. Wilmington, Delaware. Tri-State Bird Rescue and Research. 1-28.

Lemmetyinen, R. 1966. Jäteöljyn vesilinnuille aiheuttamista tuhoista Itämeren alueella. (Damage to waterfowl caused by waste oil in the Baltic area). Suomen Riista 19:63-71. (English translation available as Canadian Wildlife Service TR-FIN-8)

The problem of oil pollution in the Baltic is reviewed. The recorded destruction of birds in the Baltic area by oil pollution is as follows:

1952, ca 35,000, mainly Long-tailed Ducks (***Clangula hyemalis***) off the coast of Gotland, Sweden.
1954, ca 10,000, mainly Long-tailed Ducks off the coast of Gotland.
1955, ca 10,000, mainly Long-tailed Ducks in Åland, Finland.
1957, ca 40,000, mainly Long-tailed Ducks off the coast of Gotland.
1960, ca 22,000, mainly Black Scoters (***Melanitta nigra***) in the Danish Archipelago.
1962, tens of thousands, mainly Long-tailed Ducks off the coast of Gotland.

The estimates are merely approximate, and probably lower than true figures. According to another estimate, many tens of thousands of birds are annually damaged by waste oil on the Swedish coast alone. The number of Long-tailed Ducks migrating through Finland in 1958-1960 was one tenth of what it had been in 1937-1940. A decrease in the number of Velvet Scoters (***Melanitta fusca***) has been noted in Sweden.

Levy, E.M. 1980. Oil pollution and seabirds: Atlantic Canada 1976-77 and some implications for northern environments. Marine Pollution Bulletin 11(2):51-56.

Chemical analyses of the oils on dead or moribund seabirds from Atlantic Canada during the winter of 1976-77 indicated that some of the birds were contaminated with oil spilled by the ***Argo Merchant*** grounding, some by oil probably from the ***Grand Zenith*** sinking, and still others by oil from various small local spills of unknown origin. These victims demonstrated that an extremely minute oiling may lead to the death of a seabird when the effects of the oil are synergistically combined with the stresses imposed by severe environmental conditions. This may intensify the impact of oil in the Arctic and thereby have a profound effect on seabird populations. (as)

Lewis, H.F. 1942. Destruction of waterfowl by oil. Wilson Bulletin 54(3):217.

Along the Atlantic coast of Canada, large quantities of floating oil, most of it present as a result of war activities, caused the destruction in three local areas of thousands of seabirds during the latter part of the winter of 1941-42. The casualties included several thousand Common Eiders (***Somateria mollissima***), Brunnich's Murres (***Uria lomvia***) and Dovekies (***Plautus alle***), and hundreds of mergansers, goldeneyes, Oldsquaws (***Clangula hyemalis***), Black Guillemots (***Cepphus grylle***) and Razorbills (***Alca torda***).

Lewis, S.J. 1982. Effects of oil on avian productivity and population dynamics. Dissertation Abstracts International B. Sciences and Engineering 43(4):1026.

Avian reproductive success and population dynamics were examined in relation to oil contamination, using Great Black-backed Gulls (***Larus marinus***) and Herring Gulls (***L. argentatus***) in coordinated field and laboratory experiments. Eggs dosed with ≥ 10 ml of Kuwait crude or No. 2 fuel oil during the first third of incubation experienced significantly reduced hatching success. Embryos contaminated past the midpoint in their development were resistant to oiling. The embryotoxicities of the test oils reflected their content of polycyclic aromatic hydrocarbons and were unaltered by several weeks of weathering. Factors affecting the sensitivities of different species to egg oiling are discussed. Young hatching from oiled eggs grew and survived normally. Compensation for oil-induced egg losses through renesting was minor.

Herring Gull chicks suffered significant mortality following external contamination with 3 ml of crude oil or fuel oil. However, laboratory experiments indicated that it would be unlikely for adults to transfer such quantities to their young through brooding. Ingestion of up to 6 ml of either test oil per kg body weight did not alter growth, survival, or organ characteristics of 8- to 22-day-old Herring Gulls.

Information presented and summarized in the dissertation should facilitate the establishment of guidelines for petroleum exploration, development, and transportation that will eliminate or minimize adverse impacts on birds and other biological resources. (maa)

Lewis, S.J. and R.A. Malecki. 1984. Effects of egg oiling on larid productivity and population dynamics. Auk 101(3):584-592.

Small quantities of petroleum may adhere to the plumage, feet, or nest materials of breeding birds and be transferred to their eggs during incubation. In this study, oil was applied to naturally incubated Great Black-backed Gull (***Larus marinus***) and Herring Gull (***L. argentatus***) eggs, and its effects on reproductive success were assessed. Embryo survival was inversely proportional to the quantity of petroleum applied to eggshell surfaces. Dose responses, however, were dependent on embryonic age at the time of treatment. Eggs of either species, treated with 10-20 μl of No. 2 fuel oil 4-8 days after laying, experienced significant reductions in hatching success. Embryos oiled past the midpoint of the 28-day incubation period were insensitive to as much as 100 μl of petroleum. Fuel oil weathered outdoors for several weeks was as toxic as fresh oil to larid embryos. Productivity estimates obtained following various oil treatments indicated that only under severe conditions (e.g. large doses of petroleum contaminating young embryos) could egg oiling have a significant impact upon populations of the Herring Gull and species with similar life-history characteristics. Species that are more sensitive to oil, however, those having lower reproductive potentials and higher postfledging mortality rates or those subject to other stresses, may be more adversely affected by oil pollution. (aa)

L'Hardy, J.P. 1962. Le rôle du mazout dans la destruction des oiseaux marins sur le littoral du Finistère. (The role of oil in the destruction of seabirds on the Finistère coast). Penn ar Bed 3(29):187-191. (English translation available as Canadian Wildlife Service TR-FR-33)

The death of oiled birds under treatment is attributed to physiological shock, a state of stress to which the Alcidae are particularly susceptible. The poisonous effect of oil is discounted. Preliminary observations on the Finistère coast (Brittany) during the winter 1956-1960 indicate that Razorbills (***Alca torda***) and guillemots (***Uria aalge***) are the most frequently oiled species in the winter months.

Lincoln, F.C. 1930. The menace of oil pollution. Auk 47:546-550.

Some cases of destruction of birds along the coast of Massachusetts are cited as indication of the serious oil pollution occurring along U.S. coasts.

Lincoln, F.C. 1936. Effects of oil pollution on waterfowl. Transactions of the North American Wildlife Conference. 1:555-564.

The fate of an oil-soaked bird is exposure to cold as feathers become matted and water-soaked, starvation as the bird is unable to feed, or drowning as bouyancy is lost. The destruction of seabirds and waterfowl in various incidents of oil pollution along the coastal and interior waters of the United States is cited. Actual and potential sources of pollution are oil-burning and oil-carrying cargo ships, oil wells and fields, oil terminals and loading points, and refineries and industrial plants.

Lipcius, R.N., C.A. Coyne, B.A. Fairbanks, D.H. Hammond, P.J. Mohan, D.J. Nixon, J.J Staskiewicz and F.H. Heppner. 1980. Avoidance of Mallards to colored and black water. Journal of Wildlife Management 44(2):511-518.

As a means of preventing oiling of seabirds during oil spills, experiments were designed to test the hypothesis that birds might avoid spill areas if the water were colored with some agent. Captive Mallards were deprived of food for specific periods, then placed in testing pens. Following a short habituation period the ducks were free to enter a pool. Various dyes were introduced to the water. The time between habituation and initial contact with the water was recorded. Orange appeared to be the most consistently effective colour as an aversive stimulus. No other colour exhibited consistency in eliciting an avoidance response. (st)

Lloyd, C.J., A. Bogan, W.R.P. Bourne, P. Dawson, J.L.F. Parslow and A.G. Stewart. 1974. Seabird mortality in the North Irish Sea and Firth of Clyde early in 1974. Marine Pollution Bulletin 5(9):136-140.

A routine survey by the Royal Society for the Protection of Birds Seabird Group on January 26-27, 1974 revealed an increase in the usual level of seabird mortality from north Wales around the northern Irish Sea to south-west Scotland and the east coast of northern Ireland. A spill of heavy fuel oil contributed to seabird deaths. It was believed a little over a thousand birds made up of 26 species were oiled. The most severely affected species were Razorbills (***Alca torda***), Herring Gulls (***Larus argentatus***), and guillemots (***Uria aalge***). (st)

Lockley, R.M. 1958. Seabirds and their protection. Bird Notes 28:380-383.

The decline in numbers of puffins (***Fratercula arctica***), guillemots (***Uria aalge***) and Razorbills (***Alca torda***) in island sanctuaries of Skomer, Stokholm, Ramsey, Grassholm, St. Margaret and the Cardigan Islands in Wales, Great Britain is due to predation by the more numerous Great Black-backed Gulls (***Larus marinus***), Lesser Black-backed Gulls (***Larus graellsii***) and Herring Gulls (***Larus argentatus***) and to oil pollution.

Loftin, H. 1956. Killer of the seas. Science News Letter 69(5):78.

The problem of oil pollution and the destruction of seabirds and waterfowl is especially acute off Boston. Long Island, the mouth of the Delaware River, Galveston, Texas and the banks of North Carolina, U.S.A.

***Longabucco, P.** 1980. A two-year study of waterfowl following the 1976 St. Lawrence River oil spill. M.S. Thesis. SUNY Coll. of Environ. Sci. and For. 176 pp.

Lund, H.M.-K. 1978. Oljeskadete fugler i Norge, registrering og behandling. (Oiled birds in Norway, recording and treatment.) Anser, Supplement 3:167-170. (in Swedish with English summary)

Records of how many birds have been injured or killed by oil in Norway are very incomplete. Information on 4607 birds of 42 species for which satisfactory records are available is presented. Of these, 2940 were ducks, including 1828 eiders (***Somateria mollissima***). 1078 were auks - about half of these were puffins (***Fratercula arctica***). Gulls, waders, cormorants and Shags (***Phalacrocorax carbo*** and ***aristoteles***), and fulmars (***Fulmarus glacialis***) were also victims.

Two Norwegian oil spillages with catastrophic results (more than 100 birds killed) are discussed. The first occurred at Vadsö, where in January 1973 about 50 tons of crude oil killed some 2500 birds, mostly eiders. The other was near Finsnes (province of Troms), where the tanker ***British Mallard*** was wrecked in November 1973 and several thousands tons of oil escaped. It is likely that over 3000 birds were killed, including many eiders.

The organized recording of birds injured or killed by oil is now being planned in Norway.

The author suggests that the Nordic Congress of Ornithology should recommend the setting up of a Scandinavian research centre for the treatment of oiled birds. (maa)

Macko, S.A. and S.M. King. 1980. Weathered oil: Effect on hatchability of heron and gull eggs. Bulletin of Environmental Contamination and Toxicology 25(2):316-320.

Eggs of Herring Gulls (***Larus argentatus***), Laughing Gulls (***Larus atricilla***), and Louisiana Herons (***Hydranassa tricolor***) were treated with samples of crude oil taken at a spill in Redfish Bay, Texas. Eggs were treated externally with 10 μl of oil and incubated for 12 days. Four-week-old oil caused 17% mortality in heron embryos. No mortality occurred in the heron control group. Weathered oil did not cause significant mortality of Laughing Gull embryos, probably because nearly 60% of the embryos were mid-way through incubation when treated. Embryo sensitivity to oil is greatest during early incubation. (st)

Manuwal, D.A., T.R. Wahl and S.M. Speich. 1979. The seasonal distribution and abundance of marine bird populations in the Strait of Juan de Fuca and northern Puget Sound in 1978. NOAA Technical Memorandum ERL MESA 44: 78-79,118-129. 151-391.

Bird species differ in many biological attributes such as nesting, foraging, social behavior, and response to floating oil. An analysis of these attributes is important in not only assessing the "value" of each species but also of marine habitats such as bays, shorelines, channels, and passages.

The Bird Oil Index (BOI) was developed to evaluate the importance and vulnerability to oil pollution of birds and of the various sub-regions in the Strait of Juan de Fuca and northern Puget Sound. (st)

Marine Observer XLVI(251):14-16. 1976. Marine observer's log. Birds. Eastern South Atlantic.

January 20, 1975, an uninjured but oiled Leach's Storm-petrel was found on the deck of the M.V. ***City of Liverpool*** on her way from Durban to Newport. The bird was wrapped up and put in a box in a warm place to rest. Oil from a tin of 'Natural Pilchards' was fed to the bird with an eyedropper. A solution of 'Sqezy' washing-up liquid at about 100:1 was used for washing the oil off the feathers. Following a rinse with water and a dry-off with a hair-drier, the petrel was left to rest. After spending 24 hours on the ship and travelling 480 miles, the bird left, flying strongly. (st)

Marine Observer XLVII(258):171. 1977. Marine observer's log. Birds. North Atlantic Ocean.

Four oiled Leach's Storm-petrels were found on the deck of M.V. ***Port Alberni City*** on her way from Antwerp to the Panama Canal. The birds were cleaned and fed tinned sardines. On the third day, one bird died and two successfully flew from the ship. The fourth petrel left the next day. (st)

Marine Pollution Bulletin 1(5):66. 1970a. Bird deaths mount in Alaska.

An estimated 10,000 birds were oiled in the Kodiak Islands group of Alaska during February and early March 1970. The oil was identified as Middle East crude or bunker oil but the source was not known. In most of the surveys, birds were not identified according to species. In one case, species identification was made on 29 out of 39 oiled birds recovered from Shugak, Afognak, and Spruce Islands. These included 1 cormorant, 2 gulls, 3 Pigeon Guillemots (***Cepphus columba***), 2 Common Goldeneyes (***Bucephala clangula***), 8 Common Murres (***Uria aalge***), 1 kittiwake, 2 Oldsquaw (***Clangula hyemalis***), 1 murrelet, 7 auklets, 1 grebe and 1 puffin.

Marine Pollution Bulletin 1(8):117. 1970b. For the record - 2.

Seabird casualties of routine oil pollution incidents around the British coast from November 1969 to March 1970, as compiled by Nature Conservancy, are estimated at 14,000. This is in addition to the deaths in the northern Irish Sea in the autumn of 1969.

Marine Pollution Bulletin 1(1):3-4. 1970c. How to deal with oiled seabirds.

A description is given of the booklet "Oiled Birds - What to do" (published by Nature Conservancy).

Marine Pollution Bulletin 1(3):36. 1970d. More oiled birds.

In one day a total of 728 oiled birds were counted on the south beach of Martha's Vineyard, Massachusetts, U.S.A.. Of the total, 641 were dead. The predominant victims were White-winged Scoters (***Melanitta deglandi***), Common Eiders (***Somateria mollissima***) and loons (***Gavia*** spp.). The origin of oil pollution was not determined.

Marine Pollution Bulletin 1(7):98-99. 1970e. Seychelles oil scare.

Oil pollution of the rare seabirds in the Seychelles (Indian Ocean), such as the Fairy Tern (***Anous albus***) and Lesser Noddy Tern (***Anous stolidus***) was feared when oil leaked from the grounded tanker ***Ennerdale***. Because of favourable drift, pollution was manageable and there was no appreciable fouling of a nesting island. No disastrous effect of oil on the rare species materialized.

Marine Pollution Bulletin 8(8):173. 1977. Oil kills North Sea birds.

Oiled birds started coming ashore at the Royal Society for the Protection of Birds' reserve at Bempton, Yorkshire on 8 April: they were mainly guillemots and Razorbills. Eventually 520 birds were found dead along the shore, 555 came ashore alive, and another 400 were seen out at sea. The oil was a weathered crude oil containing more vanadium, nickel, and sulphur than is usual in North Sea crudes, in a ratio similar to the heavier Middle East crudes. The incident appeared to be caused by an illegal discharge from a ship. (st)

***Marsault, B.M.** 1980. Traitements de soins à donner aux oiseaux de mer mazoutés. Le Héron 1980(1):96-102.

Martini, E. 1953. 'Ölpest' - Beobachtungen auf der Nordseeinsel Spiekeroog. (Oil plague - Observations on the North Sea island Spiekeroog). Ornithologische Mitteilungen 5(3):44-48.

Of 108 oiled birds counted on the North Sea island, Spiekeroog, from January 1951 to March 1952, 67 were Black Scoters (***Melanitta nigra***) and 14 were guillemots (***Uria aalge***). Various cleaning agents such as alcohol, ether, benzene, and hot butter were used for cleaning oiled birds. Best results were obtained with ether and hot butter.

Mathiasson, S.** 1972. The island of Dynan. ***in E. Hansen-Melander (ed.). Nature and the Environment around Malmö. Malmö Museum. Malmö. 99-124.

***Mattsson, J.** 1982. (Oil - a constant danger to seabirds). Calidris 11(1):57-62. (in Swedish)

May, J.B. 1930. Simultaneous loss of primaries in pre-nuptial moult of loon. Auk 37:412-414.

Moulting loons, (***Gavia immer***) and (***Gavia lumme***), were two of the many species affected by the oil pollution that followed the wreck of the ***Edward Lukinback***.

Mayer-Gross, H. 1967. The *Torrey Canyon* oiling disaster. British Trust Ornithological News 23:2-4.

An account of the various cleaning and rehabilitation efforts for oiled seabirds following the *Torrey Canyon* disaster is presented. The degree to which the various species of seabirds were affected is described.

McEwan, E.H. 1978. The effect of crude oils on salt gland sodium secretion of orally imposed salt loads in Glaucous-winged Gulls (*Larus glaucescens*). Canadian Journal of Zoology 56(5):1212-1213.

An attempt was made to determine the effects of the ingestion of crude oil on the secretion of imposed oral salt loads by the salt gland of seawater-maintained Glaucous-winged Gulls. Gulls were given 1.0 g (0.1% of body weight) of Bunker C or marine diesel fuel oil. Three hours later an oral salt load (3% of body weight) of salt water (0.5 N NaCl) was administered. Cloacal excreta and salt gland secretions were collected and analyzed for sodium and potassium concentrations. The ingestion of crude oil by seawater-adapted gulls did not interfere with the uptake of the NaCl load from the gut and its subsequent extrarenal excretion. (st)

McEwan, E.H. and A.F.C. Koelink. 1973. The heat production of oiled Mallards and scaup. Canadian Journal of Zoology 51(1):27-31.

A measure of the thermal conductance of the plumage of normal and oiled ducks was determined from regression analysis that related metabolic rate and ambient temperature. The heat loss of heavily oiled Mallards and scaup was 1.7 and 2 times greater than their normal values, respectively. Oiling not only tended to increase the basal heat production, but also shifted the lower critical temperature from 12 to 25°C. Attempts to rehabilitate the scaup after oiling and cleaning were rarely successful because of the plumage deterioration and the loss of water-repellency. (aa)

McEwan, E.H. and P.M. Whitehead. 1978. Influence of weathered crude oil on liver enzyme metabolism of testosterone in gulls. Canadian Journal of Zoology 56(9):1922-1924.

Experiments were conducted with Glaucous-winged Gulls (*Larus glaucescens*), to evaluate the effect of petroleum hydrocarbons on testosterone metabolism by liver enzymes, using an assay which measured the metabolism of [4-^{14}C] testosterone. Diets containing 100 and 500 mg of weathered crude oil per day had no significant effect on testosterone metabolism. (aa)

McEwan, E.H. and P.M. Whitehead. 1980. Uptake and clearance of petroleum hydrocarbons by the Glaucous-winged Gull (*Larus glaucescens*) and the Mallard duck (*Anas platyrhynchos*). Canadian Journal of Zoology 58:723-726.

Glaucous-winged Gull (*Larus glaucescens*) and Mallard duck (*Anas platyrhynchos*), fed tritiated crude oils, showed a rapid uptake of labelled hydrocarbons into tissues and plasma. About 45% of the ingested oil was excreted. After 24 h, tritiated hydrocarbon concentrations in the plasma and tissues declined to background level except for Bunker-C-fed birds and stressed, oil-fed gulls. (aa)

McGill, P.A. and M.E. Richmond. 1979. Hatching success of Great Black-backed Gull eggs treated with oil. Bird-Banding 50(2):108-113.

The effects of small quantities of oil on the hatchability of Great Black-backed Gull (*Larus marinus*) eggs under field conditions were measured. In 30 nests, all eggs were treated with 20 µl of No. 2 fuel oil; another 30 nests served as controls. Approximately 95% of all eggs were between 1 and 10 days old. A 69% reduction in hatching success occurred among the treated eggs. A critical minimum age for embryos to survive oiling seems to be about nine days. (st)

*__McKay, C.__, C. Prentice and K. Shepherd. 1983. Survey of breeding seabirds in Yell Sound, Shetland, summer 1981. Shetland Oil Terminal Environmental Advisory Group. 64 pp.

McKelvey, R.W., I. Robertson and P.E. Whitehead. 1980. Effect of non-petroleum oil spills on wintering birds near Vancouver. Marine Pollution Bulletin 11(6):169-171.

Within the period of our records, spills of vegetable oils at Vancouver harbour have caused greater losses of birds than spills of petroleum oils. Vegetable oils affect birds by feather-wetting but do not exhibit odour and slick characteristics of petroleum oils. Because most vegetable oils are edible their potential danger to aquatic birds may go unnoticed; sites of storage and transhipment of vegetable oils may be overlooked in oil spill contingency planning. (as)

*__McKnight, D.E.__ and C.E. Knoder. 1979. Resource development along coasts and on the ocean floor: Potential conflicts with marine bird conservation. Wildlife Research Report 11:183-194.

Mead, C. 1973. Cleaning oiled birds. British Trust for Ornithology News 57:4.

Detergents used in cleaning oiled birds were thought to destroy preen gland oils and thus leave birds waterlogged. It now seems the basic element of waterproofing is the fine structure of the feather, not the small amount of oil available from the preen gland. The most vital aspect of cleaning should be the complete removal of oil and the rinsing away of the cleaning agent without damaging the delicate structure of the feathers. Types of cleaning agents which traditionalists never would have considered include Shell Sol 70 and "washing-up" detergents. Another important finding is that oiled birds can be transported safely for up to four hours from their finding place, if properly packed. (st)

Mead, C. 1977. Ten years after Torrey Canyon. British Trust for Ornithology News 87:1-2.

The blow-out of ***Ekofisk Bravo*** happened shortly after the tenth anniversary of the ***Torrey Canyon*** wreck. First reports indicate there were few birds in the vicinty, and less than 5% of those seen showed signs of oiling. This would not have been the case had the blow-out occurred three months later. During the second half of July, young flightless guillemots and Razorbills leave breeding colonies in Britain and swim across the North Sea to feeding grounds off southern Norway. There are indications that parent birds who escort the young are also moulting and flightless. Almost 400,000 pairs of auks might be involved. An oil spill in the mid North Sea could wipe out not only the chicks but half the successful breeding adults from a substantial part of the British breeding range, containing more than half the total breeding population. (st)

Mead, C. 1981. The black death. British Trust for Ornithology News 112:1.

Losses of birds in five oiling incidents in Europe during December 1980/January 1981 are presented. The worst incident, in the Skagerrak, killed 30,000 birds - 55% + guillemots with large numbers of Little Auks and Razorbills. Reports of ringed birds show the northern and western populations of Scottish breeding auks are suffering the worst. (st)

***Meek, E.R.** 1982. The Orkney beached bird survey 1981-82. Bulletin Orkney Field Club 2:6-8.

***Meek, E.R.** 1983. The Orkney beached bird survey: March 1982 to February 1983. Bulletin Orkney Field Club 2:3-4.

Meek, E.R. 1985. Oil-related eider mortality in Scapa Flow, Orkney. Scottish Birds 13(7):225-228.

During February/March 1984 an unusually high mortality of eiders occurred in Scapa Flow, Orkney. Ninety-seven eiders were recovered. This comprised 32.3% of the total number of corpses found. From March 1978 to February 1983 only 3.3% of 7000 corpses examined were eiders. Of the eiders found in 1984, over 80% were adult drakes. The cause of mortality appeared to have been a crude oil spill from the Finnish tanker ***Fanny*** on February 11, 1984. The reason why eiders, especially drakes, suffered such high mortality remains to be explained. (st)

*__Mehlum, F.__ 1980. Seabirds and the Bravo blow-out at Ekofisk, North Sea. Acta Ornithologica, Warsz. 17(10):119-126.

*__Miller, D.S.__, D. Brier-Russell, F.A. Leighton, D. Phalen, D.A. Jeffrey, G. Lambert and D.B. Peakall. 1982. Effects of crude oil, dispersant and an oil-dispersant emulsion on Herring Gulls. Bulletin Mt. Desert Island Biological Laboratory 21(1981):50-53.

*__Miller, D.S.__, R.G. Butler, W. Trivelpiece, S. Janes-Butler, S. Green, B. Peakall, G. Lambert and D.B. Peakall. 1981. Crude oil ingestion by seabirds: Possible metabolic and reproductive effects. Bulletin Mt. Desert Island Biological Laboratory 20(1980):137-138.

Miller, D.S., D.J. Hallett and D.B. Peakall. 1982. Which components of crude oil are toxic to young seabirds? Environmental Toxicology and Chemistry 1(1):39-44.

Studies from this laboratory have focused on sublethal physiological effects of small amounts of ingested crude oil in young Herring Gulls (*Larus argentatus*). Clearly, the most striking effect of certain oils in gulls is the marked reduction in rates of weight gain found after administration of a single 0.2-1 ml oral dose. For example, dosing with one South Louisiana crude (obtained from the American Petroleum Institute in 1976; SLC-76) reduced weight gain by 40-80%; another SLC, obtained in 1978, had no effect. Gas chromatographic-mass spectrographic analyses of the oils indicated that SLC-1978 lacked certain aromatics. Weathering of SLC-76 over sea water for 36 h did not reduce its ability to inhibit weight gain in gulls. Both findings implicated higher weight aromatics as the active compounds. SLC-76 was split on an alumina column into aliphatic and aromatic fractions; only the aromatic fraction reduced gull rates of weight gain. Using a Prudhoe Bay crude (as toxic to gulls as SLC-76), the aromatic fraction was split into two subfractions on Sephadex LH-20. Analyses showed that one subfraction contained those aromatics with three or less rings and the other contained those with four or more rings. Only the second fraction (high molecular weight aromatics) reduced gull weight gain. These findings clearly show that oil composition is a major determinant of oral toxicity to young seabirds, and that the higher molecular weight aromatics are most effective in reducing gull weight gain. (aa)

Miller, D.S.**, S.J. Kahn, E. Shaeen, D.B. Peakall and W.B. Kinter. 1978. Effects of ingestion of a weathered crude oil on immature Black Guillemots (Cepphus grylle***) and Herring Gulls (***Larus argentatus***). Bulletin Mt. Desert Island Biological Laboratory 17:40-42.

Miller, D.S., D.B. Peakall and W.B. Kinter. 1978. Ingestion of crude oil: Sublethal effects in Herring Gull chicks. Science 199:315-317.

A single small oral dose of Kuwait or South Louisiana crude oil caused cessation of growth, osmoregulatory impairment, and hypertrophy of hepatic, adrenal, and nasal gland tissue in Herring Gull chicks living in a simulated marine environment. These findings suggest that ingesting crude oil causes multiple sublethal effects that might impair a bird's ability to survive at sea. (aa)

Miller, H.J. and S.C. Whitlock. 1948. Detroit River ducks suffer heavy losses. Michigan Conservation 17(4):11-15.

In a period of one month, an estimated loss of 10,000 wintering ducks caused by oil pollution and yellow phosphorous occurred on the lower Detroit River. Among the oil victims, the Canvasback (***Aythya valisineria***) was most severely hit. The massive kill of ducks was brought about by the combination of oiling and cold weather. Severe weather caused ice coverage of feeding grounds and chilling of ducks whose natural insulation had been destroyed by the oil.

***Milon, P.** 1965. (Against the destruction of birds by hydrocarbons - what can each of us do). L'Homme et L'Oiseau (3):50-53. (in French)

Milon, P. 1967. La marée noire a frappé les Sept-Iles. (The black tide has struck Sept-Iles). L'Homme et L'Oiseau (9):1-12. (English translation available as Canadian Wildlife Service TR-FR-37)

On April 10, 1967, an enormous slick from the ***Torrey Canyon*** struck Sept-Iles, northern Brittany, the most important seabird nesting ground in France, at a time when all the nesting birds had just arrived and when a great many seabirds nesting further north were passing over the sea. Both Breton breeders and the birds migrating north were hit by the oil. The oiled birds brought to Perros-Guirec for treatment consisted of Razorbills (***Alca torda***), guillemots (***Uria aalge***), puffins (***Fratercula arctica***), Shags (***Phalacrocorax aristotelis***), gannets (***Sula bassana***), Black-throated Loons (***Gavia arctica***), Horned Grebes (***Podiceps auritus***), Herring Gulls (***Larus argentatus***), Red-throated Loons (***Gavia stellata***), Great Black-backed Gulls (***Larus marinus***) and White-winged Scoters (***Melanitta fusca***). After 23 days, about 10% of the birds had survived.

Milon, P. and C.E.F. Bourgerol. 1967. Séjour à Rouzic, du 20 au 24 Avril. (Visit to Rouzic, from April 20 to 24). L'Homme et L'Oiseau (9):12-13. (English translation available as Canadian Wildlife Service TR-FR-37)

The damage on the breeding bird populations at Ile Rouzic, France, from the *Torrey Canyon* oil pollution was most severe among the alcids.

Puffins (***Fratercula arctica***): the population which numbered about 5,000 on April 8 was reduced to 600.

Razorbills (***Alca torda***): dropped from 800 individuals to about 100.

Guillemots (***Uria aalge***): dropped from 400 to about 100.

Shags (***Phalacrocorax aristotelis***): The population suffered a 15% decrease; more than 10% of the remaining population were spotted with oil.

Gannets (***Sula bassana***): Dying birds, though very slightly oiled, were found daily at the foot of the cliffs of their colony. In the center of the colony, 10% of the breeders bore traces of oil; the proportion climbed to 20% in fringe areas.

Gulls (***L. marinus, L. argentatus, L. fuscus***): decreased by about 10%. Five percent of the population was stained with oil.

Kittiwakes (***Rissa tridactyla***): not affected, as the majority of the birds did not arrive until April 22.

Fulmars (***Fulmarus glacialis***): out of the 40-50 birds on the island, 2 were stained with oil.

Minns, D. 1979. Sullom Voe oil spill. Scottish Birds 10(5):200.

At the time of writing, at least 3700 birds had been killed by fuel oil spilt when the tanker ***Esso Bernicia*** struck a jetty at the Sullom Voe Oil Terminal just before New Year's. Of 49 species oiled, the most severely affected as of March 3rd were: Great Northern Diver (155), Shag (644), Long-tailed Duck (307), eider (552), guillemot (345), and Black Guillemot (615). From the beginning of December to mid March, a further 2800 oiled birds, mostly auks came ashore on the east coast from Shetland to the Firth of Forth. (st)

Misiewicz, A. 1980. Skutki "zarazy oliwnej" w rejonie portu w Ustce. (Results of oil pollution in the environs of the port at Ustka). Chronmy Przyr. ojcz. 36(4):68-71. (in Polish)

In 1977 and 1978 beached bird surveys were made along 7 km of coastline near Ustka. A total of 104 dead birds belonging to 14 species were recovered. Of these, 69 birds belonging to 12 species were oiled. In 1977, Eurasian Coots (***Fulica atra***), Common Black-headed Gulls (***Larus ridibundus***), Oldsquaw (***Clangula hyemalis***), Herring Gulls (***Larus argentatus***), and White-winged Scoters (***Melanitta fusca***) comprised 88% of all oiled birds. In 1978, ***F. atra***, ***L. ridibundus***, and ***C. hyemalis*** accounted for 89% of oiled birds. Other species found oiled in the surveys were Mew Gulls (***Larus canus***), Red-throated Loons (***Gavia stellata***), Little Grebes (***Podiceps ruficollis***), Common Eiders (***Somateria mollissima***), Razorbills (***Alca torda***), and Black Guillemots (***Cepphus grylle***). (st)

Moffitt, J. and R.T. Orr. 1938. Recent disastrous effects of oil pollution on birds in the San Francisco Bay region. California Fish and Game 24(3):239-244.

The collision of an oil tanker with a passenger steamer off San Francisco Bay resulted in an oil pollution of coastal waters along 55 miles of coastline and reaching 15-20 miles out to sea. Of the offshore species of birds, the California Murre (***Uria aalge***) was the predominant victim. Murrelets, auklets, shearwaters, and petrels were spared because the oil did not extend into their habitats. Of the avian species inhabiting the shallow bays, losses were greatest among the Western Grebe (***Aechmophorus occidentalis***), followed by the White-winged Scoter (***Melanitta deglandi***), Ruddy Duck (***Oxyura jamaicensis***), Eared Grebe (***Podiceps caspicus***) and the Red-throated Loon (***Gavia stellata***). Several species of gulls, though commonly observed in open water and shallow bays, escaped destruction because of their habit of feeding from the water on wing, and resting on salt water to a lesser extent than the other affected species. The Sanderling (***Crocethia alba***) and the Snowy Plover (***Charadrius alexandrinus***) were stained with oil, yet no mortality was observed.

Moller, H. and J.E. Tangen. 1982. Nytter det å vaske oljeskadet sjofugl? (Is it worth washing seabirds?). Var Fuglefauna 5(2):117-121. (in Norwegian with English summary)

The problems involved with treating oiled birds, and the misconceptions about treatment methods are outlined. Suggestions for successfully cleaning and treating oiled birds are provided by the RSPC centre at Little Creech. Recommendations are made for an oiled bird treatment centre at Jaeren, on the south coast of Norway. The necessity of taking punitive action against irresponsible oil companies is stressed. (st)

Monnat, J.-Y. 1967. Effects du mazout sur les oiseaux marins. (Effects of fuel oil on seabirds). Penn ar Bed 6(50):113-122.

The effect of oil pollution from the *Torrey Canyon* on 17 species of seabirds found on the coast of Brittany was assessed. The majority of species suffered only negligible losses, but alcids and gannets were decimated. Captured oiled birds suffered from starvation and reduction in body temperature of up to 20 degrees. The cleaning and rehabilitation of oiled birds is described, which in spite of all possible precautions, resulted in desiccation and cracking of tarsi, keratitis (especially in young Razorbills), and Vitamin B deficiency.

Monnat, J.-Y. 1977. Un plongeon à bec blanc *Gavia adamsii* en Bretagne: Première donné francaise. (A Yellow-billed Loon (*Gavia adamsii*) new record in Brittany: First report in France). Alauda 45 (2/3):231-234. (in French)

On October 14, 1976, the oil tanker *Boehlen* sank in l'Iroise, mid-way between the islands of Sein and Ouessant. Since then, a thousand tonnes of crude oil have spilled, causing considerable damage to the seabirds of Brittany. A rescue centre set up in Brest took in over 150 victims. Among these were 32 guillemots, 24 auks, 12 gannets, 4 Herring Gulls, 1 Mew Gull, and 1 Black-legged Kittiwake.

The most famous victim of the spill was a Yellow-billed Loon (*Gavia adamsii*). The bird was found at Porstollonecen-Crozon and was brought to the centre on November 16, 1977. It died the night of November 18-19, probably due to being oiled. This was the first record of a Yellow-billed Loon for France. (st)

*__Monnat, J.-Y.__ 1978a. Effet du petrole de l'*Amoco Cadiz* sur les oiseaux de mer. Bilan provisoire. Centre national pour l'exploitation des oceans. Actes de Colloques. Oceans 6:135-142.

Monnat, J.-Y. 1978b. Mortalitiés d'oiseaux à la suite du naufrage du pétrolier *Amoco Cadiz*. Penn ar Bed 93:339-360.

A report is given of the numbers and species of birds oiled in the *Amoco Cadiz* oil spill on the Brittany coast. Actual seabird mortality versus mortality observed, is discussed. Statistics on, and the sensitivity of, some of the major species afflicted, are outlined. The report indicates that not all of the seabird deaths were caused by the *Amoco Cadiz* spill. (st)

*__Morant, P.D.__, J. Cooper and R.M. Randall. 1981. The rehabilitation of oiled Jackass Penguins (*Spheniscus demersus*), 1970-1980. *in* J. Cooper (ed.). Proceedings of the Symposium on Birds of the Sea and Shore. 19-21 November 1979. University of Cape Town. African Seabird Group. Cape Town. 267-301.

***Morson, B.** 1978. The Argo Merchant oil spill: Impacts on birds and mammals. Conference on Assessment of Ecological Impact of Oil Spills: American Institute of Biological Science. Washington, D.C. 180-195.

Mörzer Bruijns, M.F. 1959a. Report on the numbers of oiled birds found dead on the coast of the Netherlands, 1948-1958. Proceedings of the International Conference on Oil Pollution of the Sea. 3-4 July 1959. Copenhagen. 75-76.

A beached bird survey found 3451 oiled birds along the 400 km Dutch coast during 1948-58. Black Scoters (***Melanitta nigra***) and Common Murres (***Uria aalge***) constituted 59.2% of the casualties. It is estimated that at least 17,000 oil-killed birds are annually cast ashore along the Dutch coast.

Mörzer Bruijns, M.F. 1959b. Stookolievogels op de Nederlandse kust. (Birds as victims of oil pollution on the coast of the Netherlands). Levende Natuur 62(8):172-178.

Same as above.

Mottram, W.E. 1972. Treatment and rehabilitation of waterfowl following exposure to oils. Journal of Zoo Animal Medicine 3(2):8-9.

Following contact with oil spills, birds die from physical and psychological stress, toxic effects of the oil, intestinal impactions, or starvation. Death by drowning also occurs. Instructions are given for handling, cleaning, housing, and feeding oiled birds. (st)

Mueller, A.J. and C.H. Mendoza. 1983. The Port Bolivar, Texas oil spill - a case history of oiled bird survival. American Petroleum Institute Publication 1983:521-523.

On March 9, 1982, oil from an unknown offshore source began to wash ashore near Port Bolivar, Texas. Beach cleanup was coordinated between the U.S. Fish and Wildlife Service, the U.S. Coast Guard, and local authorities. Oiled sand was removed from the beach and stockpiled for local use in road construction.

Oiled Lesser Scaup (*Aythya affinis*) appeared on the beach almost as soon as the oil did. The Fish and Wildlife Service coordinated volunteer efforts at capturing and cleaning the scaup. A total of 37 birds were captured, with 19 birds being taken in one night outing. Oiled bird cleaning began on March 10 and was completed on March 12. Procedures followed those described by Williams. Five scaup were washed three times, 31 washed twice, and one washed once.

Thirty-five scaup were released on March 15 and two on April 27. No birds died during cleaning and the survival rate of the released birds is estimated to be 89 to 97 percent. Three factors were responsible for this successful oiled bird cleanup: advance preparation in the stockpiling of supplies and the training of volunteers; the availabilty of an adequate cleanup station; and the cooperation of volunteers and government agencies. (aa)

Munthe-Kaas, L.H. 1972. Oljedrept Dverglo I Baerum. (Oil damaged waterfowl). Fauna (Oslo) 25(2):127.

An observation of an oiled Little Ringed Plover (***Charadrius dubius***) on an island 20 km south-west of Oslo near a breeding locality, is reported.

Nathan, A.J. 1972. A double marine disaster. Sea Frontiers 18(4):202-209.

Following the grounding of the tanker *Wafra* near Cape Agulhas, South Africa, an entire cargo of 63,173 tons of crude oil was liberated. Rescue operations were concentrated on Jackass Penguin (*Spheniscus demersus*) colonies on Dyer Island. Colonies were fenced in and oiled birds rehabilitated. About 65% success in rehabilitation was claimed. No figures were given for the number of birds treated.

Nature Conservancy. 1969. Oiled birds: what to do. 11 pp + appendix. 19 Belgrave Square, London, S.W.1., England.

The booklet summarizes the best advice available at the time regarding the treatment of oiled birds. Treatment of oiled birds is generally unsuccessful and research on the problems of cleaning and rehabilitation is greatly needed.

Naviaux, J.L. 1972. Aftercare of oil-covered birds. National Wildlife Health Foundation. Pleasant Hill, California. 52 pp.

The manual deals with the husbandry methods and procedures of cleaning and rehabilitating oiled birds from the time of initial recovery to release. The method recommended for cleaning oiled birds, known as Pittman-Naviaux Cleaning Technique, involves the use of solvent Shell SOL 70 and allows the cleaned birds to be released within 3 days. The common medical problems encountered in oiled birds are described and their corresponding treatments are given. A plan is outlined for an organization that will assume responsibility in caring for oiled birds in case of major oil disasters. The duties of the various members of the organization are described. Facilities, materials, and manpower for a rehabilitation center are listed.

Naviaux, J.L. and A. Pittman. 1973. Cleaning of oil-covered birds. Biological Conservation 5(4):292-294.

The technique uses a solvent that removes both contaminating oils and natural feather oils. Water-repellency is not necessarily destroyed, however, since feather structure, not natural oils gives a feather its waterproof qualities. The technique emphasizes the necessity of completely removing all the contaminating oil and cleaning agent, and ensuring feathers are disturbed as little as possible. The procedures of cleaning oiled birds are described in detail.

***Nelson-Smith, A.** 1968. A classified bibliography of oil pollution. Symposium on The Biological Effects of Oil Pollution on Littoral Communities. 17-19 February 1968. Pembroke, Wales. 172-174.

Nelson-Smith, A. 1972. Oil pollution and marine ecology. Elek Science. London. i-ix, 1-260.

Among the topics discussed is the effect of oil on marine birds. Aspects of the oil/bird problem that are outlined include losses of seabirds due to chronic oiling and catastrophic oil spills, physiological effects of oiling, vulnerability of certain species to oil pollution, and rehabilitation of oiled birds. (st)

Niess, H. 1964. Über Ölverschmutzungen an den Hamburger Alsterschwänen. (Oil pollution of Alster River swans in Hamburg). Natur und Landschaft 39(11):174-176. (English translation available as Canadian Wildlife Service TR-GER-106)

Spilled home heating oil, oily waste of industrial plants, oil wastes and grease residues of workshops, and waste oil of boats have been identified as sources of oil pollution in the Alster River. Several incidences involving oiled swans in 1955-1963 are reported. A method of cleaning and feeding oiled swans is described. Feeding is accomplished by means of a tube inserted into the bird's gullet.

*__Norderhaug, M.__, E. Brun and G.U. Möllen. 1977. Bird numbers in the Barents Sea. Conditions in relation to status, environmental problems and research tasks. Meddelelser norsk Polarinst. 104:1-119.

Norris, B.N. 1965. Caring for White-flippered Penguins. Notornis 12:185-186.

Spotted Shags (*Stictocarbo punctatus*) and White-flippered Penguins (*Eudyptula albosignata*) were worst hit when over 5,000 gallons of fuel oil was released into Lyttelton Harbour, New Zealand. Rehabilitation was attempted on a few oiled penguins. A record of the four treated birds is given.

Norsk Ornitologisk Forening. 1982a. Aktuelle oppgåver og tiltak i oljesölsituasjonar. (Current tasks and measures in oil pollution situations.) Var Fuglefauna 5(2):145-146. (in Norwegian)

Recommendations are provided for oil pollution action groups.

1. Build up a cooperation with the local Wildlife Service and establish a local action plan to be used in the event of an oil spill.
2. Report sightings of oil spills immediately to the head of the local action group.
3. Report spills to the "official national oil spill action group".
4. Ensure clean-up crews are well prepared to take action. Collect oil samples and record details of the spill. Arrange a place where dead, oiled birds can be frozen until further examination is possible. (st)

Norsk Ornitologisk Forening. 1982b. Oljen og NOF. (Oil pollution and the Norwegian Ornithological Society.) Var Fuglefauna 5(2):74-76. (in Norwegian)

This paper discusses the threat of oil pollution to birds and stresses the importance of working with oil companies to prevent disasters. (st)

O'Connor, R.J. 1967. The *Torrey Canyon*. A census of breeding auks in Cornwall, June 1967. Seabird Bulletin 4:38-45.

A census of the seabird colonies of Cornwall was carried out in June 1967. The methods used in this census are described. All species except fulmars nest preferentially on islands. Oil and detergent from the ***Torrey Canyon*** affair have certainly affected Shags and Herring Gulls, probably kittiwakes and Razorbills, and possibly guillemots. The Mount's Bay counts have been omitted from the discussion; this will affect only the account of the Great Black-back Gull. (maa)

O'Connor, R.J. and C. Mead. 1980. Oiled seabirds. British Trust for Ornithology News 110:4.

In April of this year the Trust submitted evidence relating to the frequency of oiling of seabirds to the Royal Commission on Environmental Pollution. Evidence was based on an analysis of ringing recoveries of seabirds from 1967-1978. Percentages of recovered birds that were oiled are given for ten species: guillemot, Razorbill, eider, puffin, Black Guillemot, gannet, kittiwake, Shag, fulmar and Manx Shearwater. Patterns of oiling incidents do not seem to have changed significantly over the twelve years. For most species, adult birds are most at risk. Seventy-eight percent of all oiled birds in Britain were found between December and May. In British waters the south coast has the worst incidence of oiling. The number of birds oiled in major incidents - ***Torrey Canyon*, *Christos Bitas*, *Amoco Cadiz*** - is generally far fewer than those resulting from continuing chronic pollution of the seas. (st)

Odham, G. 1971. Cleaning and rehabilitation of oiled seabirds. Proceedings of Joint Conference on Prevention and Control of Oil Spills. 15-17 June 1971. Washington, D.C. American Petroleum Institute. 453-456.

Laboratory tests of Larodan 127 on experimentally oiled Pekins showed it to be an effective cleaning and water-proofing agent. In 8-10 days, the ducks could swim. In Galve, Sweden, about 75 birds belonging to the Anatidae family were successfully cleaned and returned to their natural environment within a fortnight.

Odham, G. and E. Stenhagen. 1971. On the chemistry of the preen gland waxes of waterfowl. Accounts of Chemical Research 4(4):121-128.

The chemical composition of the preen gland wax of several species of birds is reported. The composition of preen gland waxes can provide information on the characteristics and properties required of a synthetic wax to be used in replacing the natural feather wax during rehabilitation of oiled birds. Detergent washing of oiled birds removes the natural wax which is important in maintaining water-repellency and heat insulation. Without its water-repellency, no seabird can be returned to its natural environment. Composition of preen gland secretions may be employed for taxonomic purposes.

***Office of Water Resources Research.** 1973. Oil spillage/ A bibliography/ Volume 1. Water Resource Science Information Center. WRSIC 73-207. iv + 387 pp.

***Office of Water Resources Research.** 1973. Oil spillage/ A bibliography/ Volume 2. Water Resource Science Information Center. WRSIC 73-207. iv + 446 pp.

***O'Gorman, J.C.** 1979. Swans oiled in Cork River. IWC News No.21:13.

Ohlendorf, H.M., R.W. Risebrough and K. Vermeer. 1978. Exposure of marine birds to environmental pollutants. United States Fish and Wildlife Service. Wildlife Research Report 9. 40 pp.

Among the topics covered is the effect of petroleum compounds on marine birds. Exposure to these compounds has increased with offshore oil exploration, increased tanker traffic, and the development of coastal petrochemical industries. Exposure to oil can cause serious physiological dysfunction in birds, and often leads to death. Dissolved oil fractions indirectly affect birds by poisoning or killing their food sources. Dispersants used in oil spills can also have a severe effect on marine birds. (st)

O'Keeffe, C. 1978. Oil pollution and seabirds on Irish coasts. Irish Birds 1(2):206-211.

Results of the first full-scale beached bird survey in Ireland are presented. The survey was run from December 1977 to March 1978. Of 162 dead birds found on 943 km of coastline, 42 were oiled. The highest rates of oiling occurred on the south and south-east coasts. No oiled birds were found in the north-west. The distribution of oiled birds resembles that of seaborne oil traffic and shore-based industry. Peak mortality occurred in February and March. Guillemots (***Uria aalge***) and Razorbills (***Alca torda***) were the species most frequently found oiled, and often were heavily oiled. Although 25% of the oiled birds found were gulls, few were heavily oiled. Minor oil spills appeared to be responsible for the seabird deaths. (st)

Oryx 11(5):333. 1972. Oil and the Jackass Penguin.

An estimated 5,000 Jackass Penguins (***Spheniscus demersus***) out of the 40,000-60,000 at Dassen Island, South Africa were contaminated by bilge oil released from an unidentified tanker. Of these, 2,000 were rescued and an attempt to rehabilitate them was made, at the cost of £100/day for 3 weeks.

Ouweneel, G.L. 1971. De gevolgen van de olieramp in de Biesbos voor in de winter 1970-1971 in het Hollands Diep - Haringvliet pleisterende ganzen. (Consequences of the oil disaster in the Biesbos for geese stopping over during the winter of 1970-1971 in the Hollands Diep-Haringvliet area). Limosa 44(3-4):185-188. (English translation available as Canadian Wildlife Service TR-DU-6)

The 9,000 tons of fuel oil released into the river Amer in the Netherlands polluted the Biesbos and Hollands Diep, two important haunts for geese. An estimated 2,000-2,500 geese were oiled in the Hollands Diep. Most of the oiled geese were White-fronted (***Anser albifrons***) but in terms of population, the Greylags (***Anser anser***) wintering in the area suffered most, with 50-75% of their population oiled. Other species affected were Barnacle Geese (***Brant leucopsis***) and Bean Geese (***Anser fabalis***). Oil-smeared geese were also present in the Biesbos.

*__PAD.__ 1981. (New oil threat to Oland!). Calidris 10(1):59. (in Swedish)

*__Parnell, J.F.__, M.A. Shields and D. Frierson, Jr. 1985. Hatching success of Brown Pelican (***Pelecanus occidentalis***) eggs after contamination with oil. Colonial Waterbirds 7:22-24.

Parrack, J.D. 1967a. Notes on the treatment and rehabilitation of oiled seabirds. Seabird Bulletin 3:18.

A description is given of the feeding, external care, cleaning and rehabilitation of oiled seabirds based on the material supplied by the Society for the Care of Oiled Seabirds.

Parrack, J.D. 1967b. The wreck of oiled birds in the North-east early in 1966. Seabird Bulletin 3:12-17.

Details are given of a wreck of oiled seabirds that occurred on the north-east coast of England early in 1966. The criteria for determining the age and race of guillemots in the hand, on the basis of plumage details, are discussed. Evidence is given to show that a northern population of the guillemot, probably of the race ***U.a. hyperborea***, and the Northern Razorbill (***A.t. torda***) winter off the north-east coast in hitherto unsuspected numbers. (as)

Parslow, J.L.F. 1970. Oil pollution and seabirds. Colloquium on Pollution of the Sea by Oil Spills. 2-6 November 1970. NATO Headquarters, Brussels. 11.1-11.2.

The general problem of oil pollution and its effect on seabirds is reviewed. The effects on populations of British seabirds, particularly guillemots (***Uria aalge***) and Razorbills (***Alca torda***) are assessed. The research and surveys initiated in Britain to provide information on the effects of oil pollution on seabirds are outlined.

*__Pate, L.__ 1981. Pipeline break. Wyoming Wildlife 45(1):20-23.

Pattee, O.H. and J.C. Franson. 1982. Short-term effects of oil ingestion on American Kestrels (*Falco sparverius*). Journal of Wildlife Diseases 18(2):235-242.

The Mexican Ixtoc oil well blowout resulted in extensive oil contamination along the Texas Gulf coast. This oil posed a potential hazard to migrating birds including the endangered Peregrine Falcon (*Falco peregrinus*). Laboratory tests with the American Kestrel (*Falco sparverius*) indicated that the oil:water mixture gathered at the surface of the blowout site posed little acute hazard to falcons. (aa)

Patten, S.M., Jr. and L.R. Patten. 1978. Effects of petroleum exposure on the breeding ecology of the Gulf of Alaska Herring Gull group (***Larus argentatus*** x ***Larus glaucescens***) and reproductive ecology of large gulls in the North-east Gulf of Alaska. ***in*** Environmental Assessment of the Alaskan Continental Shelf. Annual Reports of Principal Investigators. Vol. 7. Boulder, Colorado. National Oceanic and Atmospheric Adminstration. Environmental Research Laboratories. 151-310.

Primary and secondary effects of gas and oil development on large gulls (***Larus***) in the north-east Gulf of Alaska were investigated. Objectives of the study were: to determine threshold levels of petroleum exposure effects to gull reproduction under field conditions; to test alteration of incubation behavior and ability to produce replacement clutches following experimental mortality due to petroleum exposure; to analyze gull population ecology in order to determine factors influencing 'normal' reproductive success in other colonies in the northeast of Alaska; and to continue analysis of the previous data base on the reproductive ecology of large gulls in the north-east Gulf of Alaska. (mas)

Patton, J.F. and M.P. Dieter. 1980. Effects of petroleum hydrocarbons on hepatic function in the duck. Comparative Biochemistry and Physiology 65C:33-36.

1. The indocyanine green dye clearance test for hepatic function was determined in Mallard ducks before and during the chronic ingestion (7 months) of representative paraffinic or aromatic petroleum hydrocarbons (PH).
2. No mortality or visible symptoms of toxicity occurred in any of the tests. Ingestion of 4000 ppm aromatic PH produced significant increases in liver weight (25%), plasma clearance of indocyanine green (33%) and hepatic blood flow (30%).
3. Although the aromatics elicited a greater hepatic stress response than the paraffins, the ducks tolerated high concentrations of PH for extended periods. (aa)

Peakall, D.B., D.J. Hallet, J.R. Bend, G.L. Foureman and D.S. Miller. 1982. Toxicity of Prudhoe Bay crude oil and its aromatic fractions to nestling Herring Gulls. Environmental Research 27:206-215.

The physiological effects of a single dose of Prudhoe Bay crude oil (PBC), its aromatic fractions, and PBC/Corexit emulsion were studied in nestling Herring Gulls (***Larus argentatus***). The data showed that the high-molecular-weight aromatic compounds were responsible for retardation of growth and increases in adrenal and nasal gland weight. Little difference was found between PBC and the PBC/Clorexit emulsion although the latter did have a somewhat more marked effect on plasma sodium levels. (aa)

Peakall, D.B., D. Hallett, D.S. Miller, R.G. Butler and W.B. Kinter. 1980. Effects of ingested crude oil on Black Guillemots (***Cepphus grylle***): A combined field and labortatory study. Ambio 9(1):28-30.

The experimental procedure permitted carefully controlled experimentation on Black Guillemots in their natural environment. Nestlings were given a single dose (0.1 ml, 0.2 ml, or 0.5 ml) of weathered South Louisiana crude oil. Body weight gains of dosed nestlings were smaller than those of controls. Reasons for impaired weight gain may be due to alteration of intestinal transport or increased levels of circulating corticosteroid which results in increased liver glucogenesis and protein degradation. (st)

Peakall, D.B., D.A. Jeffrey and D.S. Miller. 1985. Weight loss of Herring Gulls exposed to oil and oil emulsion. Ambio 14(2):108-110.

Nestling Herring Gulls (***Larus argentatus***) given either Prudhoe Bay crude oil (PBCO) or PBCO + Corexit 9572 by intubation lost weight significantly faster than controls when faced with a food stress. Plasma sodium levels were also significantly elevated in experimental birds for the first four days. External exposure to oil emulsion caused significant weight loss in gulls not exposed to food stress, whereas external oil alone did not. (aa)

Peakall, D.B., D.S. Miller and W.B. Kinter. 1983. Toxicity of crude oils and their fractions to nestling Herring Gulls - 1. Physiological and biochemical effects. Marine Environmental Research 8(2):63-71.

The physiological and biochemical effects of ingested crude oil and their aromatic and aliphatic fractions were studied in nestling Herring Gulls (***Larus argentatus***). Single doses of 0.2-1.0 ml of two batches of South Louisiana crude oil (SLC-76 and SLC-78) were used. SLC-76 caused marked retardation of growth, some disruption of plasma osmoregulation and hypertrophy of adrenal and nasal salt gland tissue; SLC-78 had no detectable effects on gull chicks. Weathering of SLC-76 for 36 h did not reduce its toxicity and when SLC-76 was fractionated, the aromatic fraction was substantially more toxic than the aliphatic fraction. (aa)

Peakall, D.B., J. Tremblay, W.B. Kinter and D.S. Miller. 1981. Endocrine dysfunction in seabirds caused by ingested oil. Environmental Research 24(1):6-14.

In laboratory and field experiments, a single oral dose (0.1-1.0 ml) of certain crude oils or aromatic fractions caused elevated plasma corticosterone and thyroxine levels in nestling Herring Gulls and Black Guillemots. In gulls, plasma corticosterone levels were elevated within 1 day after dosing; the maximal effect was observed after 4 days (about 50% higher than control levels) and levels returned to control values after 2 weeks. Thyroxine levels did not increase until 6 days after dosing and they remained elevated after 2 weeks. Since only those oils which reduced seabird growth rates affected hormone levels, the data suggest that disruption of endocrine balance is one underlying cause of depressed growth in oil-dosed birds. (aa)

Pehrsson, O. 1981. Oljedöden slår till igen på våstkusten. (Deaths from oil pollution hit the west coast again). Var Fagelvard 40(1):69-71. (in Swedish)

Most of the big oil discharges in Swedish waters have taken place in the Baltic Sea. Around Gotland, 35,000 birds died in 1952; 40,000 died in 1957. Approximately 30,000 birds died off Oland in 1976. In Danish waters, the number of dead birds reported every year has been in the thousands since 1930. Among the big disasters mentioned are 20,000 in 1955, 17,000 in 1960, 12,000 in 1962, 15,000 in 1969, plus 12,000 and 15,000 in 1970. In November 1978, the west coast of Sweden was hit by an oil slick; 2399 dead birds were found, but the total estimate was more like 10,000.

At the end of 1980, reports started to come in about dead birds all along the Swedish, Norwegian, and Danish coasts. The ship causing the disaster has so far not been found. Preliminary reports suggest ca. 30,000 birds were killed along the Swedish coast, and 5000 died along the Norwegian south coast. Numbers from Denmark are unknown but are estimated to be much smaller. This disaster is probably the largest in this part of the world so far.

In the Baltic Sea, the Long-tailed Duck is most severely affected. In Danish waters it is mainly the Common Eider that is affected. Along the Danish Skagerrak coast, the west coast of Sweden, and the southern coast of Norway, auks are the worst hit. With knowledge about the different species of birds it ought to be possible in most cases to reduce the effects of oil discharges. (st)

Peller, E. 1963. Operation duck rescue (Minnesota). Audubon 65:364-367.

Crude oil and soybean oil was discharged into the Minnesota River as a result of an oil pipe and tank breakage. The release occurred just as ducks were coming up the Mississippi flyway and claimed an estimated 10,000 ducks. Legislation was urged to punish pollutors and to prevent oil flooding of the Mississippi by any waterway entering that river.

Pénicaud, P. 1975. Soins à donner aux oiseaux mazoutés. (Caring for oil covered birds). Le Courrier de la Nature. 36:102-103. (in French)

Some tips are given for cleaning oiled shorebirds and seabirds.

1. Act as quickly as possible.
2. Wrap the bird in a cloth to prevent it from preening and thus, ingesting oil.
3. Wash the bird in detergent and lukewarm water until there is absolutely no oil on, or under the feathers. Rinse several times with warm water.
4. Using a hair-dryer, dry the bird as quickly and thoroughly as possible.
5. Place the bird in its own large cardboard box with newspaper on the bottom. The paper must be changed each time it becomes soiled with droppings.
6. To regain the waterproofing of its plumage, bathe the bird daily in salt-water. Dry thoroughly after bathing. When waterproofing qualities are regained, release the bird on the open sea.

Feed the bird abundantly from the beginning, first with white fish (cod, etc.) to induce diarrhea and eliminate the oil, followed by whole small fish like smelt or sprats, or pieces of mackerel or other fish. In most cases the bird will have to be force-fed. (st)

Pénicaud, P. 1979. The seabird community of Sept-Iles Reserve, Brittany, France. Terre et la Vie 33(4):591-610.

Estimates were made of numbers of seabirds breeding on the Sept-Iles Archipelago, north Brittany in 1976. The evolution of seabird populations in this area from 1950-78 is outlined. The effect of oil pollution in the English Channel on puffin, guillemot, and Razorbill populations is presented. (st)

Perkins, J.S. 1983. Oiled Magellanic Penguins in Golfo San Jose, Argentina. Marine Pollution Bulletin 14(10):383-387.

During a period of 4 months prior to the 1978-1979 breeding season, a total of 157 Magellanic Penguins (***Spheniscus magellanicus***) were found dead on 1 km of beach in Golfo San Jose, a site in the vicinity of the largest nesting colony for this species in Argentina. Sixty-two of 91 adults (68%) were oiled, but only one of 66 immatures was oil-stained. Of the penguins with oil on one side only, three times as many were stained on the left side as on the right. The absence of oiled Magellanic Penguins seen at nearby nesting colonies supports the hypothesis that these birds are not fit to breed. (as)

Perry, M.C., F. Ferrigno and F.H. Settle. 1978. Rehabilitation of birds oiled on two mid-Atlantic estuaries. Proc. Ann. Conf. S. E. Assoc. Fish and Wildlife Agencies 32:318-325.

An estimated 52,500 birds died as a result of 7 major oil spills on 2 mid-Atlantic estuaries between 1973-78. Ruddy Ducks (***Oxyura jamaicensis***) constituted 98% of 12,500 birds known to have died from 5 spills on the Delaware River. Seventy-six percent of 40,000 dead birds from 2 Chesapeake Bay spills were Horned Grebes (***Podiceps auritus***) and Oldsquaw (***Clangula hyemalis***). Oiled waterfowl that were captured alive (6% of the estimated mortality) were cleaned with a variety of cleaning agents and techniques. High mortality occurred during and shortly after cleaning, and was apparently due to hypothermia and to toxicity of solvent cleaning agents. Eighty-two percent of the 3,113 birds that were cleaned died prior to or at time of release. The fate of the remaining 18% is unknown. Petroleum solvents used as cleaning agents were toxic to the birds. Most detergents left a surfactant (wetting agent) on the feathers which resulted in subsequent wetting of released birds. Although rehabilitation techniques have improved in recent years, high bird mortality can be expected following future oil spills. (aa)

Peterson, R.T., 1942. Birds and floating oil. Audubon 44:217-225.

Cases of oil pollution of birds along the Atlantic coast during the late winter of 1942 are reported. In eastern Canada, large scale destruction of seabirds occurred around the Grand Manan Archipelago, Cape Sable, and in the vicinity of Halifax. At least 13,500 birds perished around Grand Manan and another 1,800 at Cape Sable. In Monomoy, Massachusetts, U.S.A., about 25% of the approximately 20,000 wintering birds were affected. Most of these birds were Common Eiders (***Somateria mollissima***). Oil penetrated an inland water in New Jersey and killed hundreds of birds which included Black Ducks (***Anas rubripes***), scaup, goldeneyes, mergansers, loons, grebes, and Canada Geese (***Branta canadensis***). Six hundred oiled birds, mostly scoters, were observed at the beach at Black Bay refuge, Virginia. Along the North Carolina coast, hundreds of oiled birds were found, mainly Common Loons (***Gavia immer***). The occurrence of oiled Red-throated Loons (***Gavia stellata***) on fresh-water ponds is noted.

Pettersen, R. 1981. Oljesöl i Trondheimsfjorden. (Oil slicks in the fjords of Trondheim.) Var Fuglefauna 4(2):116-117. (in Norwegian)

The worst year for oil spills in Norway's history was 1980-81. A spill of Norols No. 6 fuel oil caused serious population declines for a number of bird species. Unsatisfactory clean-up equipment and delayed reporting of the spill hampered clean-up operations. (st)

Phillips, N.R. 1967. After the ***Torrey Canyon***: Results of the pollution and census of Cornish breeding seabirds in 1967. Cornwall Bird-watching and Preservation Society. 1967 Annual Report. 90-129.

The effects of the oil pollution from the ***Torrey Canyon*** and the subsequent use of detergent on the breeding seabirds of Cornwall are as follows:

The small wintering population of the Great Northern Diver (***Gavia immer***) in West Cornwall appeared to be exterminated.

The fulmar (***Fulmarus glacialis***) was unaffected by oil or detergent.

There was no evidence of decrease of the cormorant (***Phalacrocorax carbo***) population in any colony.

Of the breeding seabirds in Cornwall, the Shag (***Phalacrocorax aristotelis***) was most affected by the oil and detergent. In addition to reduction in numbers, there was some evidence of delayed and unsuccessful breeding.

The effect of oil pollution on the Herring Gull (***Larus argentatus***) populations could not be assessed as no previous count was made on this species. However, Herring Gulls were feeding avidly on marine organisms killed by the detergent. There were some indications of delayed and unsuccessful breeding for this species.

The kittiwake (***Rissa tridactyla***) was unlikely to be much affected by direct oil contamination. However, there was some evidence of late and unsuccessful breeding.

The effect on the Razorbill (***Alca torda***) populations could not be assessed as no previous counts were made. There was some evidence of delayed breeding for this species.

Accurate assessment of the damage to the guillemot (***Uria aalge***) was impossible for lack of previous counts.

The damage to the puffin (***Fratercula arctica***) could not be assessed as the colonies in Cornwall have never been counted and as the 1967 census on this species was inadequate.

Phillips, W.W.A. 1967. Oiled seabirds in Pagham Harbour in January and February 1967. Seabird Bulletin 3:18.

In the two month period, over 50 oiled birds were found dead or were rescued. They consisted mainly of Red-breasted Mergansers (*Mergus serrator*) and guillemots (*Uria aalge*). Of 30 more oiled birds seen alive at sea, most were Red-breasted Mergansers.

*__Pike, K.__ 1980. Soiled magnificance: A story of alcids and oil. Cape Nat. 9(2):34-39.

Pilgrim, E.G. 1967. Oiled seabirds in the West. Veterinary Record 81:24-25.

The cleaning, feeding, and subsequent management of birds oiled in the *Torrey Canyon* disaster is described. Of the 603 birds treated, only 5 survived.

*__Pittman, A.__ and J.L. Naviaux. 1971. Oiled-bird feather cleaning studies. National Wildlife Health Foundation. Pleasant Hill, California.

Plath, L. 1972. Ölverschmutzte Gewässer aus ornithologischer Sicht. (Oil polluted waters from an ornithological viewpoint.) Falke Monatsschrift fuer Ornithologie und Vivarienkunde Ausgabe A. 19(2):59-60. (English translation available as Canadian Wildlife Service TR-GER-92)

The causes of oil pollution and its consequences in terms of direct damage to birds and the destruction of bird habitat are reviewed.

*__Pop, R.__ 1981. Bruennich's Guillemot (*Uria lomvia*) near Monster, Netherlands, in January 1981. Dutch Birding 3(3):99.

Portier, P. 1934. Mécanisme de la mort des oiseaux dont le plumage est imprégné de mazout. (The death process in birds whose feathers have been coated with fuel oil.) Bulletin de la Société Nationale d'Acclimatation de France 81(11):449-452. (English translation available as Canadian Wildlife Service TR-FR-19)

In an experiment, a pigeon, whose feathers had been coated with fuel oil, died in a state of hypothermia after exposure for several days to temperatures between +15°C to -2°C. Experiments on ducks showed that an oiled duck on water cannot maintain its body temperature. In contrast, an unoiled duck could be kept in very cold water without loss in body temperature. The loss of insulation in an oiled bird is attributed to the disruption of feather arrangement which forces out the insulating air that is trapped in the feathers.

Portier, P. and A. Raffy. 1934. Mécanisme de la mort des oiseaux dont le plumage est imprégné de carbures d'hydrogène. (The death process in birds whose feathers have been coated with hydrocarbons.) C.R. Académie des Sciences (Paris) 198:851-853. (English translation available as Canadian Wildlife Service TR-FR-20)

A more detailed description of the experiments on the mechanism of death in oiled birds reported in Portier, 1934.

***Pottier, M.** 1981. (Victims of oil slicks). Veldornitologisch Tijdschr. 4(1):35-36. (in Dutch with English summary)

Powers, K.D. and W.T. Rumage. 1978. Effect of the ***Argo Merchant*** oil spill on bird populations off the New England coast, 15 December 1976-January 1977. In the Wake of the ***Argo Merchant***. Proceedings of a Symposium. August 1978. University of Rhode Island. Center for Ocean Management Studies. 142-148.

Bird surveys from December 15-24, 1976 found 1120 birds of 13 species near the site of the ***Argo Merchant*** oil spill. The majority of birds (almost 92%) were gulls - Great Black-backed (***Larus marinus***), Herring (***L. argentatus***), and Black-legged Kittiwake (***Rissa tridactyla***). Approximately 41% of the Great Black-backed Gulls and 59% of the Herring Gulls were visibly oiled. Beached bird surveys made between December 20, 1976 and January 24, 1977 at Martha's Vineyard and on Nantucket Island found 69 live and 112 dead birds of 16 species. Forty-nine percent were alcids, 27% gulls, and 19% loons. Internal examinations of beached birds showed lungs and kidneys were most seriously affected by oiling. It was believed the ***Argo Merchant*** oil spill did not seriously affect bird populations off the New England coast. (st)

Rand, R.W. 1952. Oil contamination - A seabird menace. Bokmakerie 4:63.

Substantial losses of penguins occurred in a widespread oil pollution of the coastal waters between Table Bay and Saldanha, South Africa in August 1952. The pollution was considered to have been due to an unavoidable leakage of oil. The penguins were the main species affected.

Randall, R.M., B.M. Randall and J. Bevan. 1980. Oil pollution and penguins - is cleaning justified? Marine Pollution Bulletin 11(8):234-237.

Oil pollution has been the main mortality factor of adult Jackass Penguins (***Spheniscus demersus***) found dead on St Croix Island, South Africa, over a 3-year period. In July 1979, 150 oiled penguins found on the island were sent to the South African Foundation for the Conservation of Coastal Birds (SANCCOB) to assess the effectiveness of cleaning and rehabilitation attempts. Oil was removed with a detergent, and in severe cases, with liquid paraffin. The mortality rate before and during treatment was 32%. Once waterproofed, the penguins were released at sea near Cape Town. By February 1980, 87% of those released had returned to St Croix Island. They appeared healthy, moulted normally, returned to former nests and mates and six had produced clutches. SANCCOB has treated 6551 oiled penguins since 1968, and, based on these release and rehabilitation rates, attempts to clean and rehabilitate oiled penguins are justified. (as)

Ranwell, D.S. and D. Hewett. 1964. Oil pollution in Poole Harbour and its effect on birds. Bird Notes 31:192-197.

The collision of an oil tanker with another ship at Poole Harbour resulted in the release of 270 tons of fuel oil. The oil spill occurred around the main area of concentration of diving birds and claimed a heavy toll of the divers, grebes and Red-breasted Mergansers (***Mergus serrator***) present. Of 487 oiled birds counted, 148 were found dead. Waders accounted for about a third of the number killed; curlews suffered heavily. The oil was soon trapped in ***Spartina*** beds and caused lesser damage to birds than if it had been on the water or on mudflat feeding grounds.

Rattner, B.A. 1981. Tolerance of adult Mallards to subacute ingestion of crude petroleum oil. Toxicology Letters 8:337-342.

Adult male Mallards were fed untreated mash or mash containing 1.5% Prudhoe Bay crude oil for 7 days ad lib. During the initial 24 h of exposure to crude petroleum oil, ducks consumed less mash ($P<0.05$) and lost approximately 3.5% of their initial body weight ($P<0.05$), however, neither intake nor body weight differ between groups on days 2-7. Plasma samples collected between 09.00 and 10.00 h on days 0, 1, 3, or 7 indicated that corticosterone, glucose, thyroxine, total protein, and uric acid concentrations, and the activities of aspartate aminotransferase (AST), alanine aminotransferase (ALT), and butyrlcholinesterase (BCHE) were not affected by treatment. These findings suggest that adult Mallards may be able to tolerate large quantities of crude petroleum oil mixed in their diet (approx. 25 ml over a 7-day period) without overt or biochemical indications of distress. (as)

Rattner, B.A. and W.C. Eastin, Jr. 1981. Plasma corticosterone and thyroxine concentrations during chronic ingestion of crude oil in Mallard ducks (*Anas platyrhynchos*). Comparative Biochemistry and Physiology 68C:103-107.

1. Blood samples were collected from Mallard ducks after 6, 12, and 18 weeks of dietary exposure to mash containing 0.015%, 0.150%, and 1.500% crude oil.
2. Plasma corticosterone concentrations in ducks fed mash containing 0.150% or 1.500% Alaskan Bay crude oil were uniformly depressed when compared to values in untreated control birds.
3. Plasma thyroxine concentration was not altered in ducks chronically exposed to crude oil.
4. The observed alteration in corticosterone concentration could not reduce tolerance to temperature and dietary fluctuations in the environment. (aa)

Ree, V. 1975. Söppel og olje langs strendene på Utsira i Rogaland hösten 1974. (Litter and oil on the shores of Utsira, Rogaland county, during autumn 1974). Fauna (Oslo) 28(4):185-195. (in Norwegian with English summary)

A number of oiled seabirds were observed during the course of ornithological field work on Utsira in autumn 1974. The situation as regards to pollution along the coasts of Norway is getting steadily worse. Due to its geographical position, Utsira is one of the localities which will be affected first in the event of an oil catastrophe in the North Sea. (mas)

Reineking, B. 1982. Reinigung verolter Seevogel - eine chance zum uberleben? (Cleaning oil-covered seabirds - A chance for survival?) Corax 9(1):1-8. (in German)

Based on English and American literature, experiences of cleaning oiled seabirds are documented and discussed. The survival rate of an oiled seabird which is cleaned, is estimated to be, at most, 0.8%. Attempts to rehabilitate oiled seabirds are critically reviewed from the point of seabird protection. Rehabilitation of oiled seabirds can perhaps only be justified for rare and endangered species. (st)

***Reynolds, P.** and B. Adam. 1981. The origins of oil collected on Orkney beaches - recent trends submitted 9th December, 1980. Bulletin of the Orkney Field Club 2:4-5.

Richardson, F. 1956. Seabirds affected by oil from the freighter ***Seagate***. Murrelet 37(2):20-22.

Casualty was greatest among the White-winged Scoter (***Melanitta deglandi***) and the Common Murre (***Uria aalge***) following the grounding of the freighter ***Seagate*** on the west side of the Olympic Peninsula, Washington, U.S.A.. Of these birds found on the shore, murres were completely covered with oil and over four-fifths were dead. Among the scoters, over half were alive and about half of these were able to fly. These species were then the abundant species offshore.

Richardson, M.G., G.M. Dunnet and P.K. Kinnear. 1981. Monitoring seabirds in Shetland. Proceedings of the Royal Society of Edinburgh. Section B. Biology 80:157-179.

The programme for ornithological monitoring in Shetland has concentrated on selected species of cliff-nesting seabirds and inshore waterfowl. Sample study sites throughout Shetland have been selected and standard counting methods derived. These have taken account of factors such as logistics and accessibility, the effects of weather and observer error and of the seasonal and diurnal variations in the numbers of birds.

Changes in seabird and waterfowl numbers between 1975-79 have been observed. These, with the exception of bird mortality following the ***Esso Bernicia*** oil spill, have been attributed to natural variation. From the scale and local differences between these as yet short-term observations, estimates are presented of the minimum percentage change required in either numbers of birds or their nests before such natural variation is exceeded.

The problems of interpreting changes in numbers are discussed.

The number of dead birds picked up in the Sullom Voe after the ***Esso Bernicia*** spill corresponded closely to that estimated from the monitoring counts before and after the incident. (as)

Richardson, M.G., M. Heubeck, D. Lea and P. Reynolds. 1982. Oil pollution, seabirds, and operational consequences, around the Northern Isles of Scotland. Environmental Conservation 9(4):315-321.

Large numbers of seabirds were killed by both acute and chronic oil pollution in the waters around the Northern Isles of Scotland in 1979. These mortalities closely coincided with the opening of the Sullom Voe Terminal in Shetland, the largest of Britain's North Sea oil-ports, and appeared to stem largely from the illegal discharge of ballast water or tank slops from tankers trading to Sullom Voe. By the middle of 1979, the seabird deaths around Orkney and Shetland had accounted for 85% of the British total of that year.

Public and political concern at these events forced the introduction of a number of non-statutory measures designed to eliminate or reduce chronic pollution offshore. In rapid and novel fashion the local authority and oil industry between them achieved a far greater degree of control than formerly over tanker traffic through the introduction of such schemes as tanker routing, 'areas of avoidance', unscheduled aerial surveillance of all tankers, rigorous inspection of ballast quality and quantity, and the introduction through chartering contracts of the necessity for vessels to carry at least 35% ballast on arrival at the port (so providing a strong disincentive to deballast at sea).

Since the introduction of these measures, pollution, in the form of oil and oiled birds coming ashore, has decreased dramatically, and is now at a level which is tolerable, considering the scale of oil-related developments in and around Orkney and Shetland. (as)

Ringleben, H. 1941. Die Ölpest - eine Gefahr für die Seevögel. (Oil pollution - a danger for seabirds). Wasser und Abwasser 40:57. (English translation available as Canadian Wildlife Service TR-GER-94)

The death process in birds contaminated with oil is described. The Washington Conference, an attempt at international agreement to control oil pollution, is cited.

Ripley, D. 1942. Oil on the sea. Audubon 44:86-90.

Numerous oiled ducks, mainly Common Eiders (***Somateria mollissima***) were observed off the coast of Massachusetts in the winter of 1940. An attempt to save some oiled eiders by transporting them to fresh-water and providing them with appropriate food has been successful, to the point of restored health and near perfect plumage in four months.

Rittinghaus, H. 1956. Etwas über die "indirekte" Verbreitung der Ölpest in einem Seevogelschutzgebiet. (On the "indirect" spread of oil pollution in a seabird sanctuary). Ornithologische Mitteilungen 8(3):43-46. (English translation available as Canadian Wildlife Service TR-GER-98)

Oil that washed ashore in 1955 at Oldenoog, a small island in West Germany, contaminated old and young terns (chiefly ***Sterna sandvicensis*** and ***S. hirundo***) and young oystercatchers (***Haematopus ostralegus***). Many adult terns became dorsally smeared with oil from their partner's oiled feet during copulation. However, no direct losses could be attributed to the oil among the adult terns. More than 70% of the young terns were contaminated with oil and many of them were unable to fly. Some of the eggs laid along the high-tide mark did not hatch after they became contaminated with oil.

Robertson, I. 1982. Vulnerability of seabirds to oil in the tropics: Modifying a North Pacific index. Pacific Seabird Group Bulletin 9(2):78.

The vulnerability to oil of seabirds of coastal Venezuela was analyzed to identify priority areas for protection. The technique used was a modification of one developed by Manuwal, Wahl, and Speich (1979) for marine bird species of Washington State. The analysis indicated that tropical seabird vulnerability to oil is considerably lower than that of the seabirds of Puget Sound. Two reasons for the difference are that i) tropical seabirds tend to spend much less time on the water; mostly, they forage from the air and roost in trees or on cliffs; and ii) warmer sea surface temperatures reduce the probabilty that oiled birds will die of exposure. (aa)

***Rogers, J.P.** 1977. International meetings on wetlands and waterfowl, United States of America. Bulletin int. Waterfowl Res. Bur. No. 43-44:43-45.

Roland, J.V., G.E. Moore and M.A. Bellanca. 1977. The Chesapeake Bay oil spill - February 2, 1976: A case history. American Petroleum Institute Publication 4284:523-527.

On February 2, 1976, a barge sank near the mouth of the Potomac River spilling about 250,000 gal of No. 6 fuel oil into lower Chesapeake Bay. Extensive beach and marsh areas on both sides of the bay were contaminated. The estimated number of waterfowl killed by the spill ranged from 20,000 to 50,000 birds. (st)

Rook, D. 1967. To clean or kill? Birds 1:209-210.

Experience has shown that the efforts in trying to rehabilitate the large number of oiled birds from the *Torrey Canyon* disaster was a failure. Humane killing of oiled birds is viewed as an alternative to cleaning. However, by attempting to save some birds, new methods of handling large numbers of oiled birds may be developed. The best advice available on cleaning methods at the time is given.

Ross, G. 1971. Our Jackass Penguins: Are they in danger? African Wildlife 25(4):130-134.

Since the closure of the Suez Canal in 1967 there has been an average of 600 oil tankers passing around the Cape every month. There have been several disastrous oil spills, killing up to 19,000 Jackass Penguins (***Spheniscus demersus***) in one incident and destroying an entire island population of 8,000 another time. Commercial egg collecting, the enlarging fishing industry and guano collecting have also helped decrease the number of penguins.

Röv, N. 1982. Olje og sjöfugl på Helgelandskysten 1981. (Oil and seabirds on the coast of Helgeland). Var Fuglefauna 5(2):91-95. (in Norwegian with English summary)

On 25 January, 1981 a 70,000 ton Greek cargo vessel, the ***Deifovos***, sank ca. 60 naut. miles west of Vega in Helgeland, Nordland. Ca. 1000 tons of heavy fuel oil polluted a ca. 1200 km^2 area of small islands along a 55-km stretch of the coast and decimated the local wintering population of auks and diving ducks. Species collected in a sample of ca. 3000 birds are listed. Four species dominated - the eider, Black Guillemot, Long-tailed Duck, and Little Auk. It is estimated that 20-30,000 birds were killed, of which ca. 10,000 were eiders and several thousand, were Little Auks. Many of the eiders were probably birds which normally breed in the Baltic, but the majority are thought to have been local birds. (mas)

Rowan, M.K. 1968. Oiling of marine birds in South Africa. Proceedings of the International Conference on Oil Pollution of the Sea. 7-9 October 1968. Rome. 121-124.

Oil pollution of South African coasts produced extensive oiling of four species of cormorants, Cape Gannets (***Sula bassana capensus***) and Jackass Penguins (***Spheniscus demersus***). Rehabilitation efforts were concentrated on oiled Jackass Penguins, a species in limited populations and limited to South Africa. Success of the rehabilitation is yet to be evaluated.

Royal Society for the Protection of Birds. 1979. Marine oil pollution and birds. Royal Society for the Protection of Birds 1-126.

The history and causes of marine oil pollution and its effects on the birds of the United Kingdom are outlined in this report presented to the Royal Commission on Environmental Pollution. Specific topics include an assessment of bird mortality, the impact of oil on birds, treatment and rehabilitation of oiled birds, causes and sources of oil pollution, legislation and regulations, and clean-up costs and procedures. Recommendations on oil pollution legislation, law enforcement, contingency planning, prevention, and clean-up are given. (st)

Runde, O.J. 1981. Sjöfugl og oljeskader i Norge 1981 Brev til Miljöverndepartmentet 6 februar 1981. (Seabirds and oil damage in Norway in 1981. A letter to the world environmental department dated 6 February 1981.) Var Fuglefauna 4(2):114-116. (in Norwegian)

A continual onslaught of oil spills hit the Norwegian coast from the Swedish border to Stadt. Large spills occurred in northern areas. Indications are that 100,000 birds died due to oil spills in 1981. Among suggestions made for alleviating Norway's oil pollution problems are:

1. More dumps are needed on land to receive waste oil from ships.
2. Heavier penalties for spills must be imposed.
3. Norway's legal jurisdiction in coastal waters should be extended.
4. Larger research grants are needed to determine seabird flyways and resting grounds.
5. A special department for oil spill control is needed.
6. Dispersal agents should be used when other clean-up methods have failed and bird populations are endangered. (st)

*__Rutschke, E.__ 1959. Strukturelle Besonderheiten der Schwimmvogelfelder. Journal für Ornithologie 100:255.

*__Rutschke, E.__ 1979. Folgen der *Amoco Cadiz* katastrophe für die Seevögel. Falke 26(8):284.

Saez, H. 1971. Bilan mycologique de quelques oiseaux avant souffert de "marée noire". (Mycological report on a few birds which suffered from oil slicks). Mykosen 14(1):31-40. (English translation available as Canadian Wildlife Service TR-FR-36).

Twenty-one oiled birds, which died in captivity in the Parc Zoologique de Paris were examined for micromycetes. Aspergillosis was rampant only among guillemots (***Uria aalge*** and ***U.lomvia***). ***Mucor***, ***Penicillium***, ***Fusarium*** and ***Aspergillus fumigatus*** in the non-parasitic state were chiefly encountered in the lungs while yeasts belonging to the types ***Candida***, ***Torulopsis***, ***Trichosporon***, ***Cryptococcus*** and ***Rhodotorula*** were found mainly in the various stages of the digestive tract. In addition to the micromycetes, coccidiosis was frequently noted in the birds examined.

***Salomonsen, F.** 1979. Marine birds in the Danish Monarchy and their conservation. Wildlife Research Report 11:267-287.

Samuels, W.B. and A. Ladino. 1984. Calculations of seabird population recovery from potential oil spills in the mid-Atlantic region of the United States. Ecological Modelling 21(1-2):63-84.

Calculations were made of Herring Gull and Common Tern population recovery from potential oil spill damage in the U.S. mid-Atlantic Outer Continental Shelf (OCS) oil leasing area. Population recovery was examined using a density-dependent age-specific life history table for each species. Both a deterministic and a stochastic approach were used in the calculations. In the deterministic approach, it was assumed that an oil spill contact to a seabird colony had occurred. Using the density-dependent model, population recovery was calculated for several different mortality scenarios. Assuming that all age classes suffer 95% mortality from an oil spill contact, a worst case scenario, it was estimated that the Herring Gull and Common Tern populations could recover to their pre-spill levels in approximately 45 years and more than 100 years, respectively. In the stochastic approach, the probabilities of oil spill contacts to these colonies were simulated during the expected 30 year active life of the lease area. For each lease lifetime, the number of oil spill contacts to a seabird colony was sampled from a Poisson distribution and assigned randomly on a seasonal basis. This analysis indicated that the oil spill risks from the development of proposed lease tracts in the mid-Atlantic region pose minimal risk (3-5%) of severe population reduction for both Herring Gulls and Common Terns. If the oil spill risks from tanker transportation of crude oil imports are included along with the proposed lease tracts, then the risks of severe population reduction are increased to approximately 10% for Herring Gulls and 18% for Common Terns. (aa)

Samuels, W.B. and K.J. Lanfear. 1982. Simulations of seabird damage and recovery from oil spills in the northern Gulf of Alaska. Journal of Environmental Management 15(2):169-182.

An oil spill trajectory analysis was performed for Proposed Outer Continental Shelf Lease Sale 55 (northern Gulf of Alaska) to analyze the probability of spill occurrence, likely movement of the spills, and the locations of biological resources vulnerable to oil spills. Ecological damage assessment and recovery of Glaucous-winged Gulls and Common Murres in the northern Gulf of Alaska were approached in two ways.

(1) Oil spill contacts were simulated in Monte Carlo fashion for a large number of simulated lease lifetimes (a lease lifetime is defined as the number of years oil production will occur). Oil spill contacts to seabird colonies, during the lease lives, were randomly sampled according to their probability distribution. Population effects were modelled according to a specified growth curve.

(2) Damage and recovery for a specific number of oil spill contacts were calculated to examine the sensitivity of the population model to growth and mortality parameters.

If an oil spill contacts a colony of gulls, reducing the population by 50%, the population is expected to recover to its pre-spill level in about 20 years. For Common Murres, this same situation yields a recovery time of approximately 70 years. Assuming that oil is found, and based on the expected number of oil spills to occur and contact these colonies during the lease lifetime, and assuming that each oil spill contact causes a fractional loss of 0.95, the probability of reducing the population to some fraction of its initial level was calculated. For gulls, only a 10% chance of population reduction to less than one-half the pre-spill level was calculated for the lease lifetime. For murres, only a 4% chance of similar reduction was calculated. (aa)

***Santa Barbara Oil Spill Information Center.** 1972. An index-catalog to the collection of the Oil Spill Information Center. Volume III. University Library, Santa Barbara, California.

Sayre, R. 1971. A center to aid volunteer bird-rescue teams. Audubon 73:113.

The International Rescue Center plans to provide training for volunteers, publish "a rescue manual" and serve as an information and research coordinator on techniques for treating oil-soaked birds. The center's address: 2701 Eighth Street, Berkeley, California.

*__Schaberick, E.__ 1977. Pflege eines verölten Weisstorches und Verhaltensbeobachtungen. Vogelkundliche Hefte 3:86-88.

*__Schmidt, G.J.A.__ 1956. Zum Vogelsterben durch Öl vor der Insel Fehmarn. (On the decrease in bird-life on the Island of Fehmarn due to oil). Mitt. Faun. Arb-Gem. Schlesw.-Holst. 9:26-28.

Schneider, U. 1981. Welche Massnahmen sind möglich, um verölte Seevögel zu retten? (What measures are possible to save an oiled seabird?). Gefiederte Welt 105(9):198-199. (in German)

Compared to England or the U.S.A., Germany has done little to save oiled seabirds. Investigations have shown that only 0.8% of oiled seabirds can be rehabilitated. Rehabilitation from the point of population ecology, then, is useless. For humanitarian reasons, rehabilitation is useful only if completely equipped treatment centres, manned with experts and assistants, are set up before a spill occurs. Oiled birds should be moved immediately to those centres where they can be treated over many months. Readers are requested to support the Jordsand Organization for the Protection of Seabirds. The address is Geschäftsstelle des Verein Jordsand zum Schutz der Seevögel e.V.z. Hd. Herrn Uwe Schneider, Birkenstieg 1,200 Hamburg 67. (st)

Schoennagel, E. 1966. Die Ölpest. (The oil plague). Ornithologische Mitteilungen 13:120.

Dead oiled birds were found on a beach of Borkum two months after the grounding of a tanker in Helgoland in the North Sea. Most of the dead birds were male Black Scoters (***Melanitta nigra***), and eiders (***Somateria mollissima***). Losses of the two species were so great that the populations of breeding birds were feared to be affected.

*__Schoennagel, E.__ 1980. Erst der Kältetod - dann die Ölpest. Ornithologische Mitteilungen, Gottingen 32(1):3-4.

Schultz, D.P.. W.W. Johnson and A.B. Berkner. 1983. A unique oiled bird rehabilitation operation - Myrtle Beach. South Carolina. February 1981. American Petroleum Institute Publication 1983:525-528.

A mystery oil spill off the east coast of South Carolina in February 1981 resulted in the oiling of an estimated 700 loons. The majority of the oiled birds came ashore within a 60-mile radius of Myrtle Beach, South Carolina. Cleanup efforts were begun by untrained volunteers. Later, the Regional Pollution Response Coordinator for the U.S. Fish and Wildlife Service, in conjunction with the International Bird Rescue Research Center, conducted a cleanup program under the aegis of the Regional Response Plan. Unique features of the cleanup effort included recruitment and training of locally available volunteers, the necessity of using locally available resources in emergency situations, and the pugnacious nature and specialized dietary requirements of the birds. The entire cleanup program lasted about three weeks and was highlighted by the successful release of 53 percent of the birds. (aa)

Simons, M.M., Jr. 1985. Beached bird survey project on the Atlantic and Gulf coasts: December 1, 1975 to November 30, 1983. American Birds 39(3):358-362.

The survey covered the United States Atlantic and Gulf coasts, from Plum and Nantucket Islands, Massachusetts to the Texas Gulf coast. Seabird oiling was frequent north of Cape Hatteras and almost nonexistent on the Florida and Texas Gulf coasts. The overall rate of oiling amongst beached birds was 6.6%. Twenty-nine species of oiled birds were recovered over the 8 year survey. The most severely affected species were the Razorbill (***Alca torda***), Masked Booby (***Sula dactylatra***), Common Murre (***Uria aalge***), Horned Grebe (***Podiceps auritas***), Oldsquaw (***Clangula hyemalis***), Thick-billed Murre (***Uria lomvia***), scaup spp., Surf Scoter (***Melanitta perspicillata***), and Common Loon (***Gavia immer***). (st)

Slominski, P. 1959. Vogeltragödie auf der Unterweser. (Bird tragedy on the lower Weser). Beiträge zur Naturkunde Niedersachsens 12:95.

After a spill of 360 tons of bunker oil in the Lower Weser River during the spring of 1959, 7032 dead ducks, mainly dabbling ducks, were counted along 14 km of the right shoreline of the Weser. On the basis of that figure, it was estimated that the total loss amounted to 14,132 ducks.

Smail, J.. D.G. Ainley and H. Strong. 1972. Notes on birds killed in the 1971 San Francisco oil spill. California Birds 3(2):25-32.

The collision of two tankers off San Francisco Bay, U.S.A., in which 84,000 gallons of Bunker C fuel oil were spilled, resulted in the estimated mortality of 20,000 birds. Its effects on the populations as a whole could not be evaluated for lack of information on the previous status of aquatic bird populations. The heaviest losses were suffered by the Western Grebe (***Aechmophorus occidentalis***), Surf Scoter (***Melanitta perspicillata***), White-winged Scoter (***Melanitta deglandi***), and the Common Murre (***Uria aalge***). The pattern of losses have been consistent with the observation that species best adapted to aquatic existence and most poorly adapted to land and flight suffer most. Species that spend the night on water were hardest hit. Some information on the race, sex, and age of the oiled birds is given.

Smith, D.C. 1972. Four parts oil and one part bird. International Bird Rescue Newsletter 1(1):2-3.

Following the 1971 San Francisco oil spill, 1,285 oiled birds were cared for by a rescue center at Richmond, California. Of these, only 15%, reported the highest rate yet achieved in a large scale rehabilitation effort, were released in healthy condition.

Smith, D.C. 1973a. Oakland oil spill. International Bird Rescue Newsletter 2(1):1,3,4 and 2(2):11.

Three hundred eight oiled birds were rescued during the Oakland Estuary (California, U.S.A.) oil spill. The majority of these birds were American Coots (***Fulica americana***), grebes, scaups, and Mallards. A solvent of low toxicity was used to clean the birds. The research undertaken on these birds included microscopic examination of feathers to analyse the varying rates of plumage recovery, a study of the effectiveness of Pimaricin drug in controlling aspergillosis, and blood tests to monitor physiological changes in treated birds. Of the total number rescued, only 46% survived and were released.

Smith, D.C. 1973b. The International Bird Rescue Research Center, Berkeley, California. Biological Conservation 5(4):294.

Among the purposes of the IBRRC are:

To secure, catalogue, and distribute scientific and educational information relating to the capture, cleaning, and care of wild birds which have been injured or diseased through pollution or destruction of their natural environment.

To make such information available to interested citizens, educational institutions, scientists, and public and private organizations.

To provide training in emergency care and treatment of wild birds for interested individuals and staff members of other agencies and organizations.

The IBRRC has provided manpower and expertise in rehabilitating oiled birds; compiled a library on fields related to wild bird care; investigated various problems related to handling and treatment of wild birds; and currently teaches a course, through the University of California, in anatomy, physiology, pathology, first aid, and husbandry, of wild birds.

Smith, D.C. 1975. Rehabilitating oiled aquatic birds. Proceedings - 1975 Conference on Prevention and Control of Oil Pollution. 25-27 March 1975. San Francisco, California. American Petroleum Institute. 241-247.

In the 1971 San Francisco oil spill, $900.00 was spent per successfully released bird, with 95% of the 4,686 treated birds dying in captivity. Through continuing research and development, those figures are improving. In 1973, the International Bird Rescue Research Center (IBRRC) treated 523 oiled birds with a 41% survival rate at a cost of approximately $15 per successfully released bird. The history, population effects, and physiological effects of oil pollution on birds are described here, and recommendations are given for treatment. The problems of maintaining aquatic birds in captivity are also discussed. Advance preparations of instructional material, equipment, and supplies have been made by the IBRRC in anticipation of future oiled-bird incidents. Additional research is indicated. (aa)

Smith, D.C. and J.S. Bleakney. 1968. Observations on oil pollution and wintering Purple Sandpipers in Nova Scotia. Canadian Field-Naturalist 83(1):19-20.

Oil pollution along the Bay of Fundy in late winter contaminated the tide pool habitat of wintering Purple Sandpipers (***Erolia maritima***). Whereas other seabirds became heavily oiled, the sandpipers accumulated a thin coating of oil from wading in pools.

Snider, R. 1977. Successful rescue of oiled ducks. Ontario Fish and Wildlife Review 16(3):3-5.

On February 2, 1976 the Niska Waterfowl Research Centre was notified of a Bunker C oil spill on the St. Clair River, several miles south of Sarnia, Ontario. Seventy-three ducks comprised of Canvasbacks (***Aythya valisineria***), Redheads (***Aythya americana***), and Greater Scaup (***Aythya marila mariloides***) were rescued. The treatment for cleaning and rehabilitating the oiled birds is outlined, and recommendations are given. Forty-five of the 73 birds were successfully released. (st)

***Snyder, S.B.**, J.G. Fox and O.A. Soave. 1973. Mortalities in waterfowl following Bunker C fuel exposure. Unnumbered report. Stanford Medical Center. Stanford, California. 27 pp.

Soikkeli, M. and J. Virtanen. 1972. The Palva oil tanker disaster in the Finnish south-western archipelago. II. Effects of oil pollution on the eider (***Somateria mollissima***) population in the archipelagos of Kökar and Föglo, south-western Finland. Aqua Fennica 1972:122-128.

The effects of oil pollution on nesting eider populations were studied on the basis of dead birds found, empty nest cups found in the subsequent year, and the change in the number of nests. In 1969, 650-750 dead or oil damaged eiders were found in the study area, and 900-1000 in the entire Kökar archipelago. In 1970, a year after the spreading of the oil, the eider population was still dense, although empty nest cups from the previous year were unusually numerous, amounting almost to two-thirds of the number of occupied nests found. It was estimated that 25-33% or 2,400-3,000 birds of the eider population nesting on the polluted area in Kökar were destroyed in 1969. In the nearby archipelago of Föglo, where long-term censuses on the waterfowl have been carried out and where the amount of oil was less, the size of the eider population increased strongly in years preceding the oil pollution, but decreased 20.6% in the worst oiled areas from 1968 to 1970. (aa)

Soldal, J. 1982. Om oljeforurensning og sjöfugl. (On oil pollution and seabirds). Var Fuglefauna 5(2):138-140. (in Norwegian with English summary)

The author describes the difficulties faced by the regional wildlife officers of the Norwegian Directorate for Wildlife and Freshwater Fish (D.V.F.) in cooperating with oil pollution defense units which are being built up by the local authorities along the coast of Norway. The D.V.F. propose that they should now be represented in the action group of each local pollution unit and thereby help in the organization of any clean-up action in the interest of any threatened seabirds. The D.V.F.'s priorities for dealing with oil spills are:

1. Censuses of seabirds and sea animals should be made prior to any oiling incidents.
2. The skill of oil pollution control personnel in dealing with, and describing the damage done by a spill, should be improved.
3. Surveys must be conducted to trace the long-term damage to birds and other wildlife.
4. Wildlife killed by a spill should be examined.
5. Oil pollution exercises should be supervised to minimize the danger to wildlife.
6. "Consequence analyses" should be encouraged before issuing new drilling and exploration permits.
7. An observation system should be established to disperse information on the extent of a spill and its damage to wildlife. (mas)

South African Department of Nature Conservation. 1970. Oiled penguins. Annual Report 25:114.

The 1:1 solution of sulphonated castor oil in water, used to remove crude oil, from penguins proved to be ineffective as plumage was left oil-stained. The attempted rehabilitation was deemed a failure.

Spencer, R. 1967. The effect on birds. Birds 1:203-204.

A table, presenting a number of bird casualties and proportions of each species affected, was issued by the RSPCA one month after the ***Torrey Canyon*** disaster. Up to that date, 7,849 oiled birds were rescued, comprising 6,355 guillemots (***Uria aalge***), 1,384 Razorbills (***Alca torda***), 42 puffins (***Fratercula arctica***), 41 Shags (***Phalacrocorax aristotelis***), 18 Great Northern Divers (***Gavia immer***), 3 gannets (***Sula bassana***), 3 Herring Gulls (***Larus argentatus***), and one each of Black-necked Grebe (***Podiceps nigricollis***), Great Skua (***Stercorarius skua***) and Black-headed Gull (***Larus ridibundus***).

Sprunck, A.O. 1971. Gefiederte Patienten. (Feathered patients). Gefiederte Welt 95(1):1-3. (English translation available as Canadian Wildlife Service TR-GER-101.)

The care of injured, starved, and oiled birds is reviewed. Oiled birds should be caught with nets and placed inside a tent. In a second, heated tent, the birds are cleaned, preferably by two people working together. After removal of the oil, the birds are rinsed with warm water and subsequently dried and kept warm. The bill and preen gland must be kept free from oil in order to prevent intoxication. The treatment should be conducted calmly to put the birds at ease. Examples of treatment for injured, diseased, and starved birds are also given.

Standring, K. and T. Stowe. 1981. Ships of doom. Birds, Royal Society for the Protection of Birds Magazine. Winter 1981:24-25.

The British and International Beached Bird Surveys showed that since January 1971, 69% of major oiling incidents occurred in the December - March period, with over 25% occurring in January. The British survey for July 1980-June 1981 showed the number of oiled bird corpses found (3195) was almost half of that for 1979-80 (6286), but was close to the annual average over the past nine years. January 1981 was probably the worst month of all time for oiled British guillemots and Razorbills. Most of the oil pollution in January appeared to have been caused by the deliberate or unreported accidental discharge of fuel oil by ships. (st)

Stanton, P.B. 1970a. Rehabilitation of oiled birds in Massachusetts. Marine Pollution Bulletin 1(9):134-136.

The methods of cleaning and rehabilitating oiled birds described herein are the same as in Stanton (1970b).

Stanton, P.B. 1970b. Separating birds and oil. Massachusetts Audubon News Letter 10(2):3-6.

Methods for the rehabilitation of oiled birds are described. The wildlife center in Upton, Massachusetts has claimed 90% survival of treated birds. Oiled birds are packed loosely in vegetable crates or cardboard boxes and taken to the center. Birds are cleaned with Polycomplex A-11 solution. Roomy shelter with a constant temperature at 60-70°F is provided. The floor is lined with serval (crushed sugar cane) to reduce incidences of aspergillosis. Only fresh-water is offered for drinking and swimming. Access to swimming water is allowed after two weeks. Food is offered but not force-fed to individual birds. Antibiotics and ointments are administered. In six months or more, birds can be released into a secluded pond from where they eventually return to the sea.

Stanton, P.B. 1972. Operation rescue. Cleaning and care of oiled waterfowl. American Petroleum Institute. Washington, D.C. 32 pp.

The physical effects of oil on birds are described, as well as the organization of a rescue operation, the techniques of collecting, and the cleaning and caring of oiled birds until the time of release into their natural environment.

***State W.A.N.S.** 3(4):85-89. 1972. Treatment of oiled seabirds.

Stickel, L.F. and M.P. Dieter. 1979. Ecological and physiological/ toxicological effects of petroleum on aquatic birds: A summary of research activities FY 76 through FY 78. United States Fish and Wildlife Service, Biological Services Program. FWS/OBS - 79/23. 14 pp.

Results are presented of laboratory and field experiments on the effects of oiling on egg hatchability, and the effects of ingested oil on physiology, reproduction, and survival. Results are given of studies on the accumulation of oil components in body tissues, and on the identification and quantification of oil components in eggs and tissues. (st)

Stowe, T. 1979. Oil pollution - the increasing toll. Birds, Royal Society for the Protection of Birds Magazine 7(8):46-47.

Sixteen oiling incidents, each involving more than 50 birds, occurred around the United Kingdom between July 1978 and June 1979. Altogether, 11,847 casualties were recorded, the highest number since the winter of 1969-70. Increased shipping traffic in seas off northern Scotland, due to oil developments, was probably responsible. The largest kill occurred in Shetland after the tanker ***Esso Bernicia*** struck a jetty at the North Sea oil terminal in Sullom Voe. A total of 3,704 dead birds were found. Losses included 15% of the Shetland wintering population of Long-tailed Ducks and 146 Great Northern Divers from an estimated wintering population of 250-400 birds. The loss of 632 Black Guillemots may also have seriously affected the local population. (st)

Stowe, T. and R. Morgan. 1979. Oil, oil, oil. British Trust for Ornithology News 98:3.

Bird losses in five major oiling incidents in Britain from October 1978 to January 1979 are presented:

October 10, 1978 ***Litiopa***
240 birds killed or incapacitated: Major species affected were guillemots, Razorbills, unid. auks, Great Crested Grebes, Common Scoters, Shags and cormorants.
October 12, 1978 ***Christos Bitas***
2200 birds oiled: Major losses incuded 200 gannets and 1900 auks, of which 1400 were guillemots.
December 30, 1978 ***Esso Bernicia***
2900 birds killed: Losses included 109 Great Northern Divers, 252 Long-tailed Ducks, 421 eiders, 454 Shags, 517 Tysties, and 249 guillemots. Forty-six species were affected.
December 31,1978 ***Andros Patria***
372 puffins killed.
January 2, 1979 East Norfolk/Suffolk
125 birds recovered: Major losses included Red-throated Divers, guillemots, Razorbills, and puffins. (st)

Stowe, T.J. 1982. An oil spillage at a guillemot colony. Marine Pollution Bulletin 13(7):237-239.

In April 1977 an oil spillage near the RSPB reserve at Bempton Cliffs, Humberside, affected over 1400 guillemots. Some casualties were not local birds. Summer counts revealed a substantial drop in the numbers of birds on the ledges. By 1978 numbers had increased dramatically, exceeding the pre-spill level. The most likely explanation for the observed fluctuations is that some birds were temporarily absent from Bempton in the summer of 1977, returning to breed in 1978. (as)

Stowe, T.J. and L.A. Underwood. 1984. Oil spillages affecting seabirds in the United Kingdom, 1966-1983. Marine Pollution Bulletin 115(4):147-152.

Oil spillages have affected large numbers of seabirds, principally auks, in the United Kingdom waters between 1966 and 1983. The annual scale of mortality has varied widely, although the worst kills are substantially less than some recorded elsewhere in N.W. Europe. Regional variations in the occurrence of mortality incidents are recorded, which in general reflect the distribution at sea of both birds and marine traffic. Oil pollution incidents affecting birds are essentially a winter phenomenon in U.K. waters and some reasons for this are discussed. (as)

*****Straughan, D.** 1971. Oil pollution and seabirds. *in* D. Straughan (ed.). Biological and oceanographical survey of the Santa Barbara Channel oil spill 1969-1970. Vol. 1. Biology and Bacteriology. Allan Hancock Foundation. Los Angeles, California. 307-312.

Stubbe, H. 1971. Fund einer verölten flungunfähigen Brandgans an der hohen Düne bie Pramort. (Finding of an oiled shelduck unable to fly on the high dunes near Pramort.) Falke Monatsschrift fuer Ornithologie und Vivarienkunde Ausgabe A. 18(9):320. (English translation available as Canadian Wildlife Service TR-GER-95.)

An observation of an oiled shelduck (***Tadorna tadorna***) unable to fly or swim is presented.

Sutcliffe, S.J. 1975. Common Scoter in Carmarthen - an oiling incident. Nature in Wales 14(4):243-249.

The importance of Carmarthen Bay as a wintering area for large flocks of Common Scoter is emphasised and the effects of a small oiling incident are described in detail. Of 88 birds recovered alive, all contaminated to some extent with a light fuel oil, only three were released to sea again. The removal of the light oil was not successful, almost certainly because initially the inexperience of the people involved did not help the cleaning process.

The birds were experimentally restrained with short lenghts of ladies stockings and this was successful. Throughout their confinement they remained aggressive towards each other and their handlers. Most birds ate large quantities of fish (mainly Sprats) and initially put on weight rapidly. It was noted that drakes weighing less than 700 g at capture did not survive. The optimum weights appeared to be 907 g (ducks) and 1077 g (drakes) and these weights were reached on average within six weeks of capture. Considerable variations in weights were noted and 'survival' weights are probably up to 30% less than the mean weights recorded. The measurements taken are a detailed record of seventeen birds kept at Lydstep and clearly illustrate the size differences of the sexes. (as)

*****Swennen, C.** 1977. Laboratory research on seabirds. Netherlands Institute for Sea Research. Texel, The Netherlands. 1-44.

*****Swennen, C.** 1978. Pollution of the Wadden Sea area. 4. Effects of pollution. 4. Oil pollution. 2. Bird mortality in the Wadden Sea caused by oil. 1. The Dutch Wadden Sea. Report Wadden Sea Working Group No. 8:85-90.

Swennen, D.C. and A.L. Spaans. 1970. De sterfte van zeevogels door olie in februari 1969 in het Waddengebied. (Seabird mortality by oil in the Wadden Sea area in February 1969). Het Vogeljaar 18 (2):233-245.

A residual fuel oil discharge in the North Sea caused the mortality of 35,000-41,000 seabirds in the Dutch Wadden Sea area in February 1969. A total of 42 species of birds were affected, with the Black Scoter (***Melanitta nigra***) and the eider (***Somateria mollissima***) suffering the heaviest mortality. The populations of both species from the Baltic which winter in the Dutch Wadden Sea are not seriously affected in view of the total Baltic populations but the Dutch breeding populations from which nearly all adults winter in the Wadden Sea are feared significantly affected. The rehabilitation rate of oiled birds in this disaster is nearly nil and more research into rehabilitation is recommended before any large-scale rescue operations can be undertaken.

Szaro, R.C. 1977. Effects of petroleum on birds. Transactions of the 42nd North American Wildlife and Natural Resources Conference No. 42:374-381.

External oiling of birds causes loss of buoyancy and insulation. Gas chromatography has been used to identify petroleum in internal organs and tissues of oil-exposed birds. Oil ingestion can cause a wide range of problems including impaired uptake of water and Na^- ions, decreased reproductive potential, lowered egg production, and temporary cessation of egg laying. It is suggested that oil ingestion causes high seabird mortality. Oil pollution can be a serious threat to seabirds that nest in large colonies and have low reproductive potential. (st)

Szaro, R.C. 1979. Bunker C fuel oil reduces Mallard egg hatchability. Bulletin of Environmental Contamination and Toxicology 22:731-732.

On the 8th day of incubation, Mallard (***Anas platyrhynchos***) eggs were externally treated with 5, 10, 20 and 50 µl of Bunker C fuel oil. A significant decrease in six-day survival and hatchability was recorded for all treatment groups. Bunker C fuel oil was only slightly less toxic than Kuwait crude oil, No. 2 fuel oil, and South Louisiana crude oil. (st)

Szaro, R.C. and P.H. Albers. 1977. Effects of external applications of No. 2 fuel oil on Common Eider eggs. *in* D.A. Wolfe (ed.). Fate and Effects of Petroleum Hydrocarbons in Marine Organisms and Ecosystems. Pergamon Press. New York. 164-167.

Because eggs of marine birds may be exposed to oil adhering to the feathers of adult birds, a study was undertaken to determine the effects of oil contamination. Two hundred Common Eider eggs (***Somateria mollissima***) were divided into four experimental sets of 50 each. Two sets were treated with No. 2 fuel oil in amounts of 5 μl and 20 μl; a third with 20 μl of propylene glycol, a neutral blocking agent. The fourth set served as a control. Hatching success was 96% for the eggs treated with 20 μl propylene glycol, 96% for the controls, and 92% for the eggs treated with 5 μl oil. Only 69% of the eggs treated with 20 μl of oil survived: a significant reduction in hatchability ($P \leq 0.05$). Mean hatching weights for all sets were statistically equal. Thus, oil pollution may significantly increase embryonic mortality in marine birds. (aa)

Szaro, R.C., P.H. Albers and N.C. Coon. 1978. Petroleum: Effects on Mallard egg hatchabilty. Journal of Wildlife Management 42(2):404-406.

On the 8th day of incubation, Mallard (***Anas platyrhynchos***) eggs were externally treated with 1, 5, 10, 20 and 50 μl of No. 2 fuel oil, and South Louisiana and Kuwait crude oils. A significant reduction in 96-h survival and 30-day hatchability occurred in all treatment groups. Eggs were also treated with propylene glycol and a paraffin mixture to test if embryo mortality could be due to gas exchange; these treatments did not affect mortality. (st)

Szaro, R.C., N.C. Coon and W. Stout. 1980. Weathered petroleum: Effects on Mallard egg hatchability. Journal of Wildlife Management 44:709-713.

The toxic effects of weathered Prudhoe Bay crude oil (PBCO) and No. 2 fuel oil on Mallard (***Anas platyrhynchos***) egg hatchability were studied. Microliter amounts of fresh, indoor-weathered, and outdoor-weathered No. 2 fuel oil and PBCO were applied externally to the air-cell end of the eggs. Results indicated the toxicity of crude and refined oils were ameliorated following 2-3 weeks of weathering. Even though weathering can lessen the impact of oil contamination on eggs of aquatic birds, oil remains a direct and persistent threat to embryo survival. (st)

Szaro, R.C., M.P. Dieter, G.H. Heinz and J.F. Ferrell. 1978. Effects of chronic ingestion of South Louisiana crude oil on Mallard ducklings. Environmental Research 17(3):426-436.

South Louisiana crude oil was fed to duckling Mallards (***Anas platyrhynchos***) in concentrations of 0.025, 0.25, 2.5, and 5.0% of the diet from hatching to 8 weeks of age to assess the effects of chronic oil ingestion during early development. Growth was depressed in birds receiving a diet containing 5% oil but there was no oil-related mortality. Diets containing 0.25, 2.5 and 5% oil, impaired avoidance behavior of 6-day-old Mallard ducklings when compared with controls or ducklings fed 0.025% oil, but had no effect on open-field behavior of 7-day-old ducklings. Liver hypertrophy and splenic atrophy were gross evidence of the pathological effects of oil in birds on the 2.5 and 5.0% diets. Biochemical lesions that occurred included elevation of plasma alanine aminotransferase and ornithine carbamyl transferase activity. Hepatocyte hypertrophy and bile duct proliferation in the liver were noted in birds fed the 2.5 and 5.0% oil diets and tubular inflammation and degeneration in the kidney were noted in birds fed the 5.0% oil diet. (aa)

Szaro, R.C., G. Hensler and G.H. Heinz. 1981. Effects of chronic ingestion of No. 2 fuel oil on Mallard ducklings. Journal of Toxicology and Environmental Health 7(5):789-799.

No. 2 fuel oil was fed to Mallard (***Anas platyrhynchos***) ducklings in concentrations of 0.5 and 5.0% of the diet from hatching to 18 wk of age to assess the effects of chronic oil ingestion during early development. Five growth parameters (body weight, wing length, ninth primary length, tarsal length, and bill length) were depressed in birds receiving a diet containing 5% fuel oil. There was no oil-related mortality. The 5% fuel oil diet impaired avoidance behavior of 9-d-old Mallard ducklings compared with controls or ducklings fed 0.5% oil. Open-field activity was greatly increased in 16-wk-old ducklings fed 5.0% oil. Liver hypertrophy and splenic atrophy were gross evidences of pathological effects in birds on the 5.0% oil diet.. More subtle effects included biochemical lesions that resulted in the elevation of plasma alanine aminotransferase and ornithine carbamoyltransferase activity. (aa)

Szczepski, J.B. 1975. Niektóre aspekty ochrony ptaków Baltyku. (Some aspects of bird conservation in the Baltic). Wszechswiat 3:62-65. (in Polish)

Because the Baltic is shallow, not very large (430,000 km^2), and surrounded by highly industrialized and urbanized countries, it is one of the most polluted bodies of salt-water in the world. Of the 1.2 million tons of toxic substances that enter the Baltic annually, 3-4 tons are oil. The main source of oil pollution is not accidental spills but the regular operation of ships at sea. In the Kiel Canal in 1955, 10,000 birds died from oiling. The main species affected were loons (***Gavia*** spp.), Great Crested Grebes (***Podiceps cristatus***), Oldsquaw (***Clangula hyemalis***), White-winged Scoters (***Melanitta fusca***), Common Eiders (***Somateria mollissima***), and mergansers (***Mergus*** spp.). In 1959, another 5000 birds were killed in the Kiel Canal. In January 1960, 5000 birds, mainly ***Alcidae***, were oiled near Gotland. Thirty thousand ducks in a wintering population of 200,000 were fatally oiled in the Kattegat in 1972. Between February 24-25, 1973, 1663 birds perished along the shores of Denmark. Several hundred birds die along Polish shores every year. Because the Oldsquaw winters along the Baltic coast, it accounts for about 70% of all oiling casualties. (st)

Szczepski, J.B. 1976. Account of oil pollution damaging the seabirds in Gdansk Bay. Przeglad Zoologiczny 20(1):75-81. (in Polish with English summary)

An examination was made of seabird deaths from 1947-1970. Of 1141 dead birds, 806 were oiled. Twenty-three species belonging to five orders were affected. Anseriformes suffered the most damage (855 birds) followed by Charadriiformes (244), Ralliformes (26), Podicipediformes (11), and Gaviiformes (5). The most severely oiled species were Long-tailed Ducks (***Clangula hyemalis***), Velvet Scoters (***Melanitta fusca***), Common Scoters (***M. nigra***), gulls (***Larus*** spp.) and auks (***Alca, Uria, Cepphus***). (st)

Taapken, J. 1978. Marée noire: een nieuwe olieramp aan de kust van Bretagne. (Black tide: A new oil slick on the coast of Brittany). Vogeljaar 26(3):101-108. (in Dutch)

The *Amoco Cadiz* spill of 223,000 tons of oil along 200 km of coastline of Brittany in March 1978, is reported. It was estimated that 25,000 birds became oil victims. Particularly affected were cormorants and Atlantic Puffins. A population decline of those two species was observed.

The oil disaster was the dominant subject in Brittany for many weeks. About 15,000 people participated in a demonstration against the *Amoco Cadiz* disaster. Thousands of volunteers and hundreds of soldiers assisted with cleaning the beaches. The author urges for the establishment of treatment centres along the whole Dutch coast for the rehabilitation of bird victims of oil spills. (st)

Taapken, J. 1981. Westeuropese olieramp voor onze zeevogels. (West European oil disaster for our seabirds.) Vogeljaar 29(1):41-43. (in Dutch)

From November 1980 to February 1981 Western Europe was greatly affected by oil pollution. At least 250,000 seabirds, mostly murres and other alcids, were affected. A breakdown according to area is as follows:

Skagerrak Kattegat: 100,000 - 200,000 victims
Danish west coast: at least 2000 victims
English south coast and Wales: 1000-2000 victims
North coast of France: at least 2000 victims
Belgian coast: 5000 victims
Dutch coast: 3000 - 5000 victims

The author discusses the lack of accommodation and financial assistance for treating oiled birds in the Netherlands. In Belgium, less than 10% of the oiled birds survive after treatment. On January 17, 1981, a quiet demonstration was held in Brussels against pollution of the sea. (st)

Tanis, J.J.C. and M.F. Mörzer Bruijns. 1962. Het onderzoek naar stookolievogels van 1958-1962. (Investigation on seabirds killed by oil pollution, 1958-1962). Levende Natuur 65(6):133-140.

On the basis of 4,953 bird casualties from oil during 1958-1962, it was estimated that at least 11,000 oil-killed birds were cast ashore along the 400 km long Dutch coast. Black Scoters (***Melanitta nigra***) and Common Murres (***Uria aalge***) constituted 58.5% of the casualties. Most casualties were found during February-April. The bird casualties for 1958-1962 in Holland showed a decline when compared with those of 1947-1958. The decline is attributed to better diagnosis and fewer catastrophes. Wind direction is an important factor in determining the number of birds cast ashore. The size and weight of the bird, type of weather, and presence of predators such as crows and gulls determine the length of time a corpse will remain and be recognizable on the beach.

Tanis, J.J.C. and M.F. Mörzer Bruijns. 1968. The impact of oil pollution on seabirds in Europe. Proceedings of the International Conference on Oil Pollution of the Sea. 7-9 October 1968. Rome. 67-74.

Oil pollution of coastal areas of Europe and the Mediterranean is illustrated on the map. The number of oiled birds caused by regular occurrence of slight pollution on the Dutch and Belgian coast has doubled during the period 1962-1968 as compared to 1958-1962. The most stricken species is the Black Scoter (***Melanitta nigra***). The real toll of oil pollution can amount to 10 times or more the number of birds dead or dying on the coast. The consequences of normal oil pollution has not yet been disastrous even to the most stricken group, the Alcidae, in view of the breeding populations. But the consequences of extensive oil pollution as a result of shipping disasters can be overwhelming when a species is concentrated in breeding, moulting, migrating or wintering areas.

Tarshis, I.B. and B.A. Rattner. 1982. Accumulation of ^{14} C-naphthalene in the tissues of Redhead ducks fed oil-contaminated crayfish. Archives of Environmental Contamination and Toxicology 11:155-159.

Crayfish, artificially contaminated with ^{14}C-naphthalene-5% watersoluble fraction of No. 2 fuel oil, were force-fed to one-year-old Redhead ducks to determine the accumulation of petroleum hydrocarbons. The relative distributiion of carbon-14 activity in the gall bladder containing bile, and fat were similar, and significantly greater ($P<0.05$) than the activity in the blood, brain, liver, and kidney. There was a significant increase ($P<0.05$) in the disintegrations per minute per gram (dpm/g) in the blood, brain, kidney, and liver between days 1 and 3 of feeding, indicating a progressive accumulation of carbon-14 activity (naphthalene and presumably its metabolites). There was no significant effect of sex or the interaction of the duration of feeding and sex on carbon-14 activity in any of the tissues. The low daily dose of petroleum hydrocarbons (a total of approximately 1.25 mg/day) received by the ducks from the crayfish and the relatively short feeding regimen did not cause any overt signs of toxicity in the ducks. (aa)

Technical Advisory Committee in Oil Pollution on the Tay. 1968. Oil pollution in the Tay Estuary, 1968, following the ***Tank Duchess*** incident. Corporation of the City of Dundee, Publications Department. 26 pp, 1 map.

The report reviews the oil pollution of the Tay Estuary, Scotland, the methods and action taken to combat the pollution, and the effects of oil on birds and other estuarine organisms. The number of oiled birds found dead or captured alive totalled 1,360. The predominant victim was the eider (***Somateria mollissima***), and in this incident, between 5 and 25% of the British eider population perished.

Thomas, A. 1981. Recensements d'oiseaux marins echoues en Bretagne. Bilan de 1978 a 1980. Penn ar Bed 104:15-29. (in French)

Results of beached bird surveys along the Brittany coast in 1979 and 1980 are presented, and compared with results of British surveys. All oiled birds found in Brittany were victims of chronic oil pollution, not large spills. The numbers and species of oiled birds found in beached bird surveys on the Baie d'Audierne coast in 1978-79 and 1979-80 are also presented. Some of the main species affected were Atlantic Puffins (***Fratercula arctica***), Razorbills (***Alca torda***), Common Murres (***Uria aalge***), Northern Gannets (***Sula bassana***), Herring Gulls (***Larus argentatus***), Black-legged Kittiwakes (***Rissa tridactyla***), and oystercatchers (***Haematopus ostralegus***). (st)

Thomas, A. and J.-Y. Monnat. 1983. Consequences sur l'avifaune d'un incident petrolier mineur. Oiseau 53(2):105-120. (in French with English summary)

The accidental discharge of thirty or forty tons of crude oil in Douarnenez Bay (Finistère, France) in April 1979 caused the death of about 100 seabirds, of which more than 70% were auks. Luckily, the impact on nearby seabird colonies was slight. The interest of a study of such an incident is due to its completeness: the onset of the accident, the relative impact of the oil slicks and the finding of nearly all the corpses. (as)

Thomas, D.K.** 1979. Oil pollution in Gower from the ***Christos Betas. Gower 30:52-53.

Ticehurst, N.F. 1938. Oiled birds resorted to fresh water. British Birds 31(11):354-355.

Oiled Black Scoters (***Melanitta nigra***), Velvet Scoters (***Melanitta fusca***) and Red-throated Divers (***Gavia stellata***) were observed in fresh-water. Oiled corpses of these birds are regularly seen at fresh-water pools in the winter. It is thought an irritant poison in the ingested oil drives these seabirds to fresh-water.

Tottenham, K. 1959. The oil menace. Audubon 61:28-30.

A method of treatment that has often proved successful in reviving oiled birds is described. A 24-hour rest is prescribed prior to cleaning, and during that time the bird is swathed in cotton-wool, kept at 70°F room temperature and force-fed, if necessary. Cleaning with Fuller's earth or prepared chalk is recommended at 2-day intervals until feathers are clear of oil. Difficulty in handling was encountered with a gannet but adaptation to a domestic life was observed in a shearwater, a murre, and a Razor-billed auk. Feather-wetting remained a problem in all treated birds despite their regained strength and clean feathers.

Trivelpiece, W.Z., R.G. Butler, D.S. Miller and D.B. Peakall. 1984. Reduced survival of chicks of oil-dosed adult Leach's Storm-petrels. Condor 86(1):81-82.

The effects of sub-lethal oil ingestion by adult Leach's Storm-petrels (***Oceanodroma leucorhoa***) on the survival and growth of their chicks was studied. Adults were dosed with Prudhoe Bay crude oil (PBCO) at different stages of brooding. Chicks were weighed when adults were dosed, and at three-day intervals for 21 days thereafter. A sub-sample of adults were later killed, and livers, nasal glands, and adrenal glands were removed and weighed. In a final experiment, chicks weighing about 28 g were dosed with PBCO and weighed at three-day intervals for 21 days.

Decreased survival and reduced growth rates in chicks of oil-dosed adults may be related to impaired ability of adults to provide food for their young. Direct transfer of oil to the young is unlikely to account for the changes observed since the direct dosing of chicks did not affect their growth rate. Observed changes in organ weights of adults showed significant hypertrophy of nasal and adrenal glands. Liver weights were not significantly altered by exposure to PBCO. (st)

Tuck, L.M. and J.A. Livingston. 1959. Oil pollution in Newfoundland. Proceedings of the International Conference on Oil Pollution of the Sea. 3-4 July 1959. Copenhagen. 76-79.

The areas of heavy seabird mortality from oil pollution in Newfoundland are the eastern and western shores of the Avalon Peninsula, the north shores of Bonavista Bay, and the shores along the Strait of Belle Isle. Seabird mortality resulting from oil pollution, though a continuous affair, is most serious in the winter when Common Eiders (***Somateria mollissima***) concentrate inshore, and murres (***Uria*** spp.) concentrate offshore. The murres suffer most heavily, followed by the eiders. On one count, the mortality of Thick-billed Murres (***Uria lomvia***) was as high as 463 per lineal mile in a portion of the Avalon Peninsula. In spite of regulations prohibiting oil dumping within 50 miles offshore, oil pollution continues to aggravate, since ocean currents and wind carry the oil dumped outside the limit into Newfoundland shores. Rezoning of prohibited areas is necessary to protect the eiders which congregate inshore, and the murres which drift on the Labrador current from the eastern Canadian Arctic and west Greenland to the waters adjacent to Newfoundland. The area should extend 300 miles east and south-east of Newfoundland; It should also include the whole Gulf of St. Lawrence, and extend into the Atlantic a sufficient distance north and east of the northern end of the Strait of Belle Isle to offset the carrying effects of the Labrador current.

Ummels, J. 1983. Vogels slachtoffer van olieramp op rivier de Maas in December 1981. (Birds as victims of an oil slick on the Maas River in December 1981). Vogeljaar 31(1):3-6. (in Dutch)

On December 8, 1981, 100 tons of heavy oil entered the Maas River when a tanker hit a piling . After the spill, 240 dead and oiled birds were found on the river. They consisted mostly of Mallards, coots, rails, Black-headed Gulls, and thrushes. During a 2.5-h count of 360 thrushes feeding along the river bank, 50% were seen to be smeared with oil. From evidence in the literature, it was thought that most oil-smeared thrushes would die. On the basis of the extent of the thrush migration and the ratio of observed oil-smeared thrushes, it was estimated that 3000-4000 thrushes became oil victims. The total number of victims was estimated at 8000-10,000 birds. Of 106 captured and treated oiled birds, only 5% survived.

Several measures were taken to prevent more waterbirds from becoming oiled. A resting place for waterbirds, consisting of a water-filled gravel pit, was closed off with an oil boom. Another resting place could not be sealed off because of the strong current. The accident showed there was a general lack of organization in dealing with an oil spill on a river. The author provides some advice on how the effects of a future spill on birds can be curbed. (st)

***United States Department of the Interior.** 1970. Summary report, Kodiak oil pollution incident, February-March 1970. 28 pp.

Upright, V. 1977. Oil spills: Not if - when? New hope for oiled birds. New Jersey Audubon 3(10):169-171.

On December 27, 1976, the Liberian tanker ***Olympic Games*** ran aground in the Delaware River and spilled 135,000 gallons of highly toxic, light Arabian crude oil. The myriad of problems encountered in cleaning birds oiled in the spill is discussed. Only 4% of the cleaned birds survived. The disaster prompted the Delaware Audubon Society to conduct oiled bird seminars and workshops and to initiate a "Tri-State Oiled Bird Rescue Program". (st)

Vaas, K.F. 1971. Oil ravages the Biesbosch. Marine Pollution Bulletin 2(4):51-52.

A ruptured oil storage tank on the southern bank of the Meuse River, Holland, released more than half of its 16,000 tons of crude oil into the Biesbosch area, an important wintering ground for some 10,000 geese. After the disaster, the number of geese in the area decreased considerably and many dead birds were discovered.

Valste, J.** 1983. Effect of the ***Antonio Gramsci oil spill on the avifauna of the Finnish south-western archipelago. Ornis Fennica Suppl. 3: 3:112-113.

Van der Ham, N.** 1981. Observation of Ross Gull (Rhodostethia rosea***) at Camperduin, Netherlands, January 1981. Dutch Birding 3(1):16-17.

Van Esbroeck, B. 1978. Roodkeelduiker - ***Gavia stellata***. (Red-throated Diver (***Gavia stellata***)). Wielewaal 44(4):117. (in Dutch)

On December 31, 1977 an oiled Red-throated Loon was seen preening itself upside down in the water. The bird was still there on January 2, 1978. (st)

Vangilder, L.D. and T.J. Peterle. 1980. South Louisiana crude oil and DDE in the diet of Mallard hens: Effects on reproduction and duckling survival. Bulletin of Environmental Contamination and Toxicology 25:23-28.

Reproductive success was significantly affected when Mallard hens were fed diets with 2% South Louisiana crude oil or 10 ppm DDE. Although egg fertility was not affected, the onset of laying was delayed in birds fed either pollutant, and hens fed SLCO produced 36.6 ± 7.4% fewer eggs than control hens. Egg shell thickness was reduced by 5% in eggs of DDE-fed birds and 16% in eggs of SLCO-fed birds when compared with controls. Hatchability of eggs from DDE and SLCO hens was 22.2 ± 10.0% and 45.0 ± 11.3% lower, respectively, than eggs of control hens. Duckling survival was reduced by 5.1 hours for DDE birds and 9.7 hours for SLCO birds when compared with controls. Thermoregulation was impaired in ducklings of pollutant-treated hens. (st)

Vangilder, L.D. and T.J. Peterle. 1983. Mallard egg quality: Enhancement by low levels of petroleum and chlorinated hydrocarbons. Bulletin of Environmental Contamination and Toxicology 30:17-23.

To examine single effects and interactions of pollutants on egg quality, Mallard (*Anas platyrhynchos*) hens were fed either a control diet or a diet containing 0.5% (v/w) South Louisiana crude oil (SLCO), 5 ppm DDE, or 0.5% (v/w) SLCO + 5 ppm DDE. Egg quality was defined in terms of size, the amount and relative proportions of the shell, yolk and albumen, the composition of certain components, hatchability, and duckling survivorship. Eggs laid by ducks fed SLCO + DDE were of better quality than those laid by ducks on any other diet. Enhanced egg quality was probably due to the positive effects of SLCO on egg size and composition and the antagonism of DDE to the embryotoxic effects of SLCO. Pollutant-induced effects may be positive or negative depending upon the dose level, the life history of the organism, and the interactions with other pollutants. Current methods for assessing biological impacts of chronic low level pollution may be too simplistic. (st)

van Gompel, J. 1981. De massale zeevogelsterfte aan de Belgische kust tijdens de voorbije winter. (The mass seabird mortality on the Belgian coast during last winter). Wielewaal 47(4):137-142. (in Dutch with English summary)

From November 1980 to February 1981, at least 4000 seabirds were found on the Belgian coast as a result of oiling incidents. Species involved were guillemots (± 2000), Brünnich's Guillemots (2), Razorbills (± 280), Little Auks (12), puffins (2), fulmars (± 150), gannets (14), Common Scoters (± 30), Red-throated Divers (8), kittiwakes (± 500), and other *Laridae*. (mas)

Van Kampen, D.M. 1971. Successful cleaning of oiled birds in Holland. Marine Pollution Bulletin 2(9):140-142.

"Panolec" and a formulation of "Purcellin" emulsion were effective in cleaning and waterproofing heavily oiled swans, geese, coots, and Mallards. The success claim was based on the 55% complete recovery within three weeks. Tests of single feathers showed "Larodan 127" to be ineffective in removing oil and improving water-repellency.

Varoujean, D.H. 1982. Seabird - oil spill behavior study. Pacific Seabird Group Bulletin 9(2):78.

As part of a study funded by the U.S. Bureau of Land Management, seabird interactions with floating oil were examined in an area of naturally-occurring oil seeps off Coal Oil Point, Santa Barbara Channel, California. The purpose of the study was to provide new information about the vulnerability of seabirds to oiling. During baiting experiments, juvenile Brown Pelicans, Western Gulls, and Heermann's Gulls made contact with oil seepage slicks more than did adults. Furthermore, during these experiments, Heermann's Gulls, classified as nonresidents of the Santa Barbara Channel (and presumably less frequently exposed to oil slicks) made contact with oil more than did Western Gulls. These results indicate that seabirds previously exposed to oil are more apt to avoid oil in the future.

Observations of seabirds resting and feeding in the vicinity of oil slicks documented that 15-25% of the loons, grebes, shearwaters, ducks, phalaropes, jaegers, and terns observed made contact with oil, whereas 40% of the Brown Pelicans, cormorants, Western Gulls, and Heermann's Gulls observed made contact with oil. That 40% of the cormorants made contact with oil supports the contention that diving species are more vulnerable to oiling. The high frequency of oil contact by pelicans and gulls indicates that non-diving seabirds may also be vulnerable to oiling. (ct)

Vauk, G. 1978. Seabirds as indicators of accidental marine pollution in the Helgoland area, German Bight. Veröffentlichungen des Institutes für Meeresforchung in Bremerhaven 17(1):95-100.

Of 116 dead or dying sea birds collected at Helgoland beaches from January to April 1978, 56 (mostly guillemots and kittiwakes) had died from an oil spill of unknown origin and extent. (st)

Vauk, G. 1980. Zum Ablauf des Seevogelsterbens als Folge "scleichender Ölpest" auf Helgoland im Frühjahr 1979. (Deaths of seabirds following the creeping oil pollution on Helgoland in spring 1979). Vogelwarte 30(3):271-276. (in German with English summary)

During the months January to April 1979, 232 birds were found dead on Helgoland. Deaths were caused by the effects of oiling. In contrast to earlier findings, the highest losses occurred in the ducks (Common Scoter); however, grebes (Red-necked Grebe) and guillemots also constituted a high proportion of the oil victims.

The hard winter, with freezing conditions, led to a special concentration of marine and fresh-water birds on the open sea around the island.

Waders and a blackbird also fell victim to oil that had been washed ashore.

Oil was sampled from the plumage of three birds and analysed to ascertain its origin. Very likely the oil did not originate from the North Sea oil fields but from drifting raw oil.

It was proved by the ringing of oiled birds that light oiling of a Greater Black-backed Gull could be overcome by the bird itself. (as)

***Vauk, G.** 1981a. Ölpestbericht Helgoland 1980. Seevogel 2(1):63-66. (in German with English summary)

***Vauk, G.** 1981b. Seevogelverluste durch Ölpest in einigen Gebieten an der Schleswig-holsteinischen Nordseekuste in den Monaten November 1980 bis Januar 1981. Seevogel 2(1):60-62. (in German with English summary)

Vedel-Tåning, A. 1951. Olieforurening af havet og massedöd af fugle. (Oil pollution of the sea and mass destruction of birds). Naturens Verden 35(1/2):34-43. (English translation available as Canadian Wildlife Service TR-DAN-7).

Two types of oil pollution are discussed. One type is the dumping of waste oil by ships. This caused the deaths of thousands of sea ducks, mostly eiders (***Somateria mollissima***) and Black Scoters (***Melanitta nigra***) in Danish waters, mainly from mid November to early February, 1938-1950. The other type is a "natural" oil pollution which resulted from the mass death of diatoms near Doggerbank in 1947. The dying diatoms, mostly ***Coscinodis cus concinnus*** and ***C. centralis***, released multitudes of oil droplets which formed an extensive whitish-grey oil slick on the surface of the sea. Murres were caught and debilitated in this slick while fulmars were reported to eat the oil.

***Vedel-Tåning, A.** 1952. Oljedoden. (The oil death). Sveriges Natur 5.

Vereshchagin, N.K. 1946. Gibel'ptits ot nefti v Azerbaidzhan. (Death of birds from oil in Azerbaidjan). Zoologicheskii Zhurnal 25(1):69-80. (Translation available as Canadian Wildlife Service TR-RUS-277).

The history of the problem of oil pollution in the Caspian Sea is reviewed. In recent periods, the mass deaths of birds by oil are due to the development of the oil industry and the contamination of the sea and land by oil. In Azerbaidjan the sources of pollution are drainage of oily refinery effluent into the Caspian Sea, offshore drilling, dumping of oily ballast water, spills during transfer and loading operations, and accidental breakage of pipelines. On land and small bodies of water, oil pollution results mainly from flooding of vast areas with oily drill water, construction of open reservoirs, and utilization of lakes as settling tanks for drill water. Oil pollution exacts a heavy toll on birds during mass migration. The predominant victims at sea are the coot (***Fulica atra***) and Tufted Duck (***Aythya fuliqula***), while inland, most affected are the Mallard (***Anas platyrhynchos***), Pintail (***Anas acuta***), Common Teal (***Anas crecca***) and the coot. Study on the Binagady tar shows that natural terrestrial seepage had occurred at the end of the Pleistocene. Comparison of the species found trapped in the tar with the contemporary victims of oil pollution shows considerable shifts in composition and quantitative ratios since the end of the Pleistocene era. Coots and Tufted Ducks were absent in the Binagady tar.

Vermeer, K. 1976. Colonial auks and eiders as potential indicators of oil pollution. Marine Pollution Bulletin 7(9):165-167.

Colonial auk (alcid) populations can be used as indicators of the effects of oil pollution on the seabirds of Canada's coastal zones. Of approximately 11 million breeding colonial alcids in Canada and adjacent Greenland waters, 87% are murres. Common Eiders may serve as the best indicators of the effects of oil pollution in Canada's western Arctic where colonial alcids are scarce. (aa)

Vermeer, K. and G.G. Anweiler. 1975. Oil threat to aquatic birds along the Yukon coast. Wilson Bulletin 87(4):467-480.

A survey along the Yukon coast in August and September 1973 showed that approximately 5500 Oldsquaws and 4500 Surf Scoters use the reef barrier-enclosed bay between Herschel Island and the mainland. No other such large sea duck concentrations were observed along the Yukon coast. Oldsquaws and Surf Scoters will be the most likely victims of potential oil spills because of their concentrations, long molting periods, reaction to spills, and nearness to expected oil exploration activities. Large numbers of Brant and Northern Phalaropes, which stop during migration in coastal lagoons and river deltas, will also be vulnerable to oil pollution, although to a lesser extent than the sea ducks, because of their relatively short migratory stops. (as)

*__Vermeer, R.__ and K. Vermeer. 1974. Oil pollution of birds: An abstracted bibliography. Canadian Wildlife Service. Manuscript Reports No. 29. 68 pp.

Vermeer, K. and R. Vermeer. 1975. Oil threat to birds on the Canadian west coast. Canadian Field-Naturalist 89(3):278-298.

The potential effects of oil spills on aquatic birds and their feeding habitat on the Canadian west coast are assessed and the related literature on oil pollution is reviewed. Present shipping and transport of oil and increased tanker traffic along the entire British Columbia coast in 1977 constitute a threat of destruction of birds from oil spillage.

Concentrations of seabirds will be most vulnerable to spills. Three major colonies along the coast of British Columbia are the Langara region, the south-east coast of the Queen Charlotte Islands, and the Scott Islands. Alcids and storm-petrels are the most numerous seabirds along the British Columbia coast. Alcids are among the birds most vulnerable to oil pollution, whereas storm-petrels are less threatened by spills than alcids because they spend more time in the air and only dive occasionally. Waterfowl, especially diving ducks, will be vulnerable to spills during the winter as they concentrate in large numbers in estuaries and inlets along the British Columbia coast. The large wintering populations of ducks, geese, and grebes along the Fraser Delta foreshore and Boundary Bay will be endangered because of their nearness to tanker and shipping traffic. Approximately one million loons, shearwaters, phalaropes, ducks, gulls, and geese migrate because of their concentration in large numbers, may be very temporarily but critically vulnerable to oil pollution.

The birds most likely to be directly affected by spills are breeding populations of alcids and wintering diving ducks, whereas ducks, geese, and shorebirds, which feed in the intertidal zone, may be hardest hit indirectly through destruction of their feeding habitat. Of the ducks threatened by destruction of their feeding habitat, seaducks are most vulnerable of all ducks as they rely most on the marine habitat for feeding purposes. (aa)

Verwey, J. 1922. The moult of ***Uria troille*** (L.) and ***Alca torda*** (L.). Ardea 2:99.

The state of maturity and moult of oiled guillemots (***Uria troille***) and Razorbills (***Alca torda***) picked up in regular surveys of the Dutch coast is reported.

Vogt, H. 1964. Die Ölpest - der schwarze Tod für die Seevögel! (Oil pollution - the black death of seabirds). Vogel-Kosmos (2):42-43. (English translation available as Canadian Wildlife Service TR-GER-96).

The problem of oil pollution in relation to increasing world production and transport of oil is reviewed. Some prohibitive and preventative measures are discussed. The fate of oiled birds is described.

Voluntas. 1962. Olievelden bedreigen zeevogels. (Oilfields endanger seabirds). Nederlandse Jager 67:544.

Forty countries ratified an agreement in London in 1962 to prohibit the dumping of oil in the Baltic, North Sea, Persian Gulf, Red Sea, and the Arabian Gulf: and off north-east America, the west coast of Canada, and the Atlantic coast of Spain and Portugal. Dumping is also prohibited 100 miles from the Mediterranean coast, and in the waters around Australia. Only those countries who ratified the agreement are bound to it. That means that countries who did not sign the agreement can still dump oil into those seas.

*__von Schwind, H.__ 1975. Die Kormoran - Tragödie bei Swakopmund. Mitteilungen orn. Arb Gruppe SWA wiss Ges. 10(3-5):1-2.

*__Ward, P.__ 1978. Elusive tankers decimate bird-life. Bulletin Army Bird Watch Society 2:21-22.

Westphal, A. 1969. Jackass Penguins: Their treatment, care and release after contamination by crude oil and other oil products. Marine Pollution Bulletin 14:2-7.

Penguins affected with weathered oil are cleaned with liquid paraffin, while those affected with fresh crude, or other types of oil, are cleaned with Fuller's earth. Repeated wetting and preening by allowing the birds access to sea rock pools or fresh-water tanks improves the water-repellency of the plumage and the general condition of birds. A diet of pilchard is most satisfactory to penguins. Antibiotic treatment is administered to sick birds. The rehabilitation period is from 2-4 weeks. Rehabilitated birds are ringed before release. Success of released birds could not be evaluated for lack of observations.

Westphal, A. and M.K. Rowan. 1970. Some observations on the effects of oil pollution on the Jackass Penguin. Ostrich (Supplement) 8:521-526.

The rehabilitation of freshly oiled Jackass Penguins (***Spheniscus demersus***) was found more successful than the rehabilitation of birds with a previous history of oiling, cleaning and premature release. Mortality among the freshly oiled group amounted to only 23% (4 out of 17). All beached penguins weighed, on the average, only 2/3 of their normal weight, but under treatment and with a diet of oily fish (e.g. pilchard), weight gains were rapid. Bacteriological examinations of 42 birds revealed pathogenic infections in over 50% of those examined. Infectious bacteria found were of a coagulase-positive strain of ***Staphylococcus aureus***, a major killer, ***Salmonella typhimurium***, strains of ***Escherichia coli*** and members of the ***alkalenseens/dispar*** group. The Jackass Penguin is suggested to be in danger of extinction resulting from egg collecting, apparent competition with man for its food, and oil pollution.

*__Wheeler, M.E.__ 1982. An abstracted bibliography of literature related to potential long-term manifestations of chronic, low level oil pollution on aquatic birds in Alaska. Department of Environmental Conservation (Alaska). 18 pp.

White, D.H., K.A. King and N.C. Coon. 1979. Effects of No. 2 fuel oil on hatchability of marine and estuarine bird eggs. Bulletin of Environmental Contamination and Toxicology 21:7-10.

Eggs of Louisiana Herons, Sandwich Terns, and Laughing Gulls were oiled with either 0, 5, or 20 µl of No. 2 fuel oil in the field and in the laboratory. After 5 days of natural incubation, field-oiled and control eggs were opened and embryonic mortality was determined. No. 2 fuel oil produced 61% mortality in Louisiana Heron eggs, 56% in Sandwich Tern eggs, and 83% in Laughing Gull eggs.

Hatching success of artificially incubated, oiled eggs appeared to be lower than in control eggs. However, stress during shipment to the laboratory and problems within the incubator probably contributed to reduced hatchability in both groups. (as)

Wiens, J.A., R.G. Ford and D. Heinemann. 1984. Information needs and priorities for assessing the sensitivity of marine birds to oil spills. Biological Conservation 28(1):21-49.

Our experience in developing models to predict the potential impacts of oil spills on colonially breeding marine birds has revealed some major gaps in the information available on these systems. We consider the availability of data for a variety of parameters of seabird biology that are required in modelling efforts, and assign provisional priorities to our information needs. In order to develop means of predicting the impacts of oil spills on seabirds, we suggest that colony- or site-specific information on the timing of reproduction and colony occupancy, chick growth rates and body weights, several metabolic parameters, flight speed, and food load size is of relatively low overall priority. Intermediate priority is assigned to the collection of specific data on the dynamics of oil spills, the age and breeding structure of the populations, reproductive success, foraging activity budgets and flight paths, flight costs, and the response of growing chicks to food deprivation. We suggest that studies of seabird biology should give highest priority to obtaining information on population sizes, the probabilty of adult death upon encountering a spill, age-specific fecundity and survivorship, the time required in foraging trips, the lag time in the response of birds to an oil spill, foraging rate as a function of resource density, and changes in the availabilty of resources to the birds as a consequence of oil spills. (aa)

Wild, O.H. 1925. Observations on seabirds and oil. Scottish Naturalist 1925:71-72.

An account is given of the observations made on oiled beached birds at Aberlady, East Lothian, Great Britain during the periods 1917-1924. Prior to the war, the occasional oiled bird was noted, but oiled birds became more common around 1917. The birds involved were hundreds of guillemots, many Razorbills, and some puffins and scoters.

Williams, A.S., S.C. Brundage, E. Anderson, J.M. Harris and D.C. Smith. 1978. Saving oiled seabirds: A manual for cleaning and rehabilitating oiled waterfowl. American Petroleum Institute. 35 pp.

Details are given on the physical effects and long-term stresses of oiling, safety precautions and techniques for handling wild birds, collection and treatment methods at spill sites and rehabilitation centres, determining cases for euthanasia, preparation and maintenance of holding pens, feeding suggestions and techniques, vitamin dosages, cleaning and drying procedures, and preparation for release of treated birds. (st)

Williams, J.K. 1967. *Torrey Canyon*: Detergent and wildlife. Birds 1:207 208.

It is estimated that 2 million gallons of detergent were used to disperse the oil and clean up the beaches polluted with oil following the ***Torrey Canyon*** disaster. Birds showed damage in the alimentary and vascular systems and skin burning, which were attributed to detergents. Except for the early toll of guillemots (***Uria aalge***) and Razorbills (***Alca torda***), the oil itself had done far less damage to life than the detergent which had been used.

***Williams, P.F.** 1980. Arrangements for dealing with oiled birds in the event of a major oil pollution incident affecting the Gwent coast. Newsletter Gwent Trust Nat. Conserv. 1980(Autumn). 2 pp.

***Wilson, G.J.** 1977. Oiled penguins in Antarctica. Antarctic Rec., Christchurch 2(2):3.

***Wolk, K.** 1975. Oil pollution on the Polish coast of the Baltic Sea. Ochr. Przyr. 40:229-246.

Wootton, T.A., C.R. Grau, T.E. Roudybush, M.E. Hahs and K.V. Hirsch. 1979. Reproductive responses of quail to Bunker C oil fractions. Archives of Environmental Contamination and Toxicology 8(4):457-463.

Bunker C fuel oil was extracted with petroleum ether and the concentrated extract was given to breeding Japanese Quail (***Coturnix coturnix japonica***). A dose of extract equivalent to 300 mg Bunker C reduced both egg production and hatchability. Fractionation of the extract by absorption on Florisil and elution with petroleum ether followed by chloroform yielded fractions that were tested for toxicity. All the fractions had a pronounced effect upon production; however only the chloroform eluates were found to affect hatchability of the eggs. (aa)

World Wildlife Fund - Pressestelle. 1977. Folgen der Ölpest. (Results of the oil plague). Vogel Heimet 47(9):200. (in German)

American researchers have established that oil affects egg structure and egg-laying of quail. One half gram of heavy oil added to the quail diet stopped most laying. Of the eggs that were laid, few hatched due to thin shells or changes in the egg yolk. Fourteen days after the experiment, the quail resumed normal egg-laying. Similar observations were made of Canada Geese given heavy oil in their diet. (st)

Wright, P. 1971. High pollution toll of Shetland seabirds. London Times (June 7, 1971):3.

Preliminary estimates of the oil pollution toll of Shetland seabirds put the death toll as high as 10,000. Most harm has been around Bressay Island, part of one of the most important breeding grounds of northern European seabirds. The source of the pollutant is unknown.

***Zimmerman, J.** and J.A. Frank. 1977. Oiled bird rescues: Governmental and volunteer action. Tri-State Bird Rescue. Wilmington, Delaware.